NATIONAL BUREAU OF STANDARDS REPORT

9050

Morphology of the Nevada Cattlebrands and Their Blazons

Part One

U.S. DEPARTMENT OF COMMERCE

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NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT		NBS REPORT
205-205-2050404	February 10, 1966	9050

Morphology of the Nevada Cattlebrands and Their Blazons

Part One

By

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Applied Mathematics Division

To the

National Institutes of Health
(NB-65-8)

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FOREWORD

Originally projected as a short sketch of forty pages or so, this paper on the Nevada cattlebrands has turned out to be so sprawling as to make it impossible of publication as a whole, except formally and between boards. I think it probable that the present treatment can be improved; and so, pending its perfection, I have resorted to less formal publication, in three parts.

Part 1, presented here, contains the Introduction to the subject, as well as all of Chapter 1, which deals with the brands' "iconics", or pictorial properties.

Part 2 contains Chapters 2 ("Blazonry") and 3 ("Syndeictics")---dealing, respectively, with the "readings" which are given brands, and with the way these "readings", or "blazons", can be computed from the iconic specification of the brands.

Part 3 will contain Chapters 4 ("Ambiguity"), 5 ("Total View of the Brands as a System"), and 6 ("'Iconics' and 'Syndeictics'"); in addition, at the end of Part 3 the Appendices will be printed in full, together with a complete Index.

Because the Morphology is being published in fragments, I have to a certain extent made each Part independent, in providing for each a cumulative Index and as much of the Appendices as seems needed for an understanding of the references to them.

Morphology of the Nevada Cattlebrands and Their Blazons

PART ONE

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Morphology of the Nevada Cattlebrands and Their Blazons

William C. Watt

The Nevada cattlebrands and their blazons offer an unusually tractable example of a highly codified system of associated pictorial sources and descriptions thereof. A "syndeictic" analysis of this brand-and-blazon system is presented and related to the general problem of analyzing such systems by means of techniques drawn from linguistics.

"Open A E Combined"

0. Introduction.[1]

The subject-matter of this paper will be almost entirely that suggested in its title: an analysis of the structure of the Nevada cattlebrands, such as the one given just above, and of their associated "readings," or "blazons," such as "Open A E Combined." I will begin,

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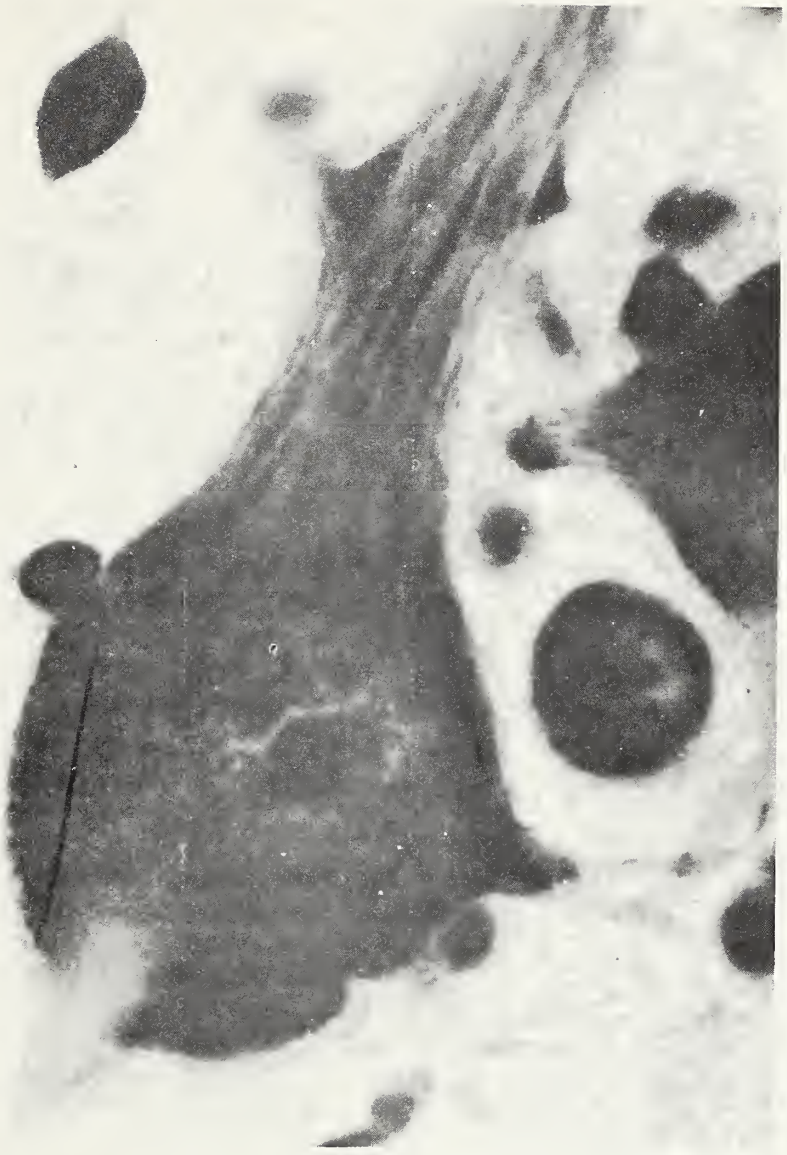
1 This paper has benefited from discussions with Russell A. Kirsch; Robert W. Hsu and B. Kirk Rankin III; and Lewis E. Lipkin. The typing and illustration of this study have been supported in part by the National Institutes of Health, under agreement NB 05613-01. I would like to express my thanks for this support and for the willingness of at least one NIH representative to see the connection between this work and the computer analysis, synthesis, and description of biological images. I would like to extend special thanks to Alice M. Hanssen, editor of the Nevada Brand Book, for her helpfulness in matters pertaining to this report.

however, with a justification for my having undertaken this study, for the reader who is not yet assured of its intrinsic interest may well wonder what motivated it. Unhappily, the time is not yet at hand when the linguist can expect that his analysis of the Nevada cattlebrands will be taken seriously per se.

My attention was first drawn to cattlebrands because they seemed to offer the possibility of studying, in a relatively simple and highly codified system, properties of a much more complex system. I refer to the class of pictorial sources examined and described by neuro-pathologists engaged in the study of brain-tissue; an example of such a picture, with an associated description (or 'blazon'), is presented in Figure 1. There are, to be sure, obvious differences between the above-given brand and its blazon on the one hand, and Figure 1 and its blazon on the other. It is readily apparent that Figure 1 shows a picture of much greater complexity than does the brand; the description is correspondingly more complicated. More significantly, perhaps, the brand has only the one correct blazon (though this is not true for all brands), while the blazon given for Figure 1 is only one of many such; even if we could imagine such a thing as a "complete" description of Figure 1, any such description would have very many paraphrases, each also a "correct" and "complete" description. It is in this sense that I refer to the Nevada brand/blazon system as being "codified;" the brain-section/blazon system is "uncodified" in this sense.

Lest it appear that the differences between these two systems so far outweigh the similarities as to make a comparison of them without

FIGURE 1



BLAZON: "The largest cell in the picture represents a large pontine neuron. It is noteworthy in demonstrating the axon hillock as an area of pallor at about 7 o'clock. The nucleus is poorly defined but does contain a prominent dense nucleolus. The usual arrangement of Nissl substance is encountered with parallel orientation present in the large dendritic process extending toward 1 o'clock. Two small cells adjacent and partially (apparently) in contact at 4 and 10 o'clock are neuronal satellites. To the right, the roughly circular medium-sized neuron probably represents one of the association class. An additional neuron is partially represented on the extreme right." (LEL,1/7/66).

point, I would like to invite attention to some areas of resemblance. To understand how the brain-tissue blazons relate to their pictures it is necessary first of all to understand those pictures: it is necessary to analyze them, to analyze the blazons, and to analyze the connection between the two. What properties of the picture (so considered) are reflected in the blazons---and of these, which are reflected habitually and easily? Which properties are left out? In what respects are the blazons ambiguous, describing more than one (non-identical) picture? To what degree is this ambiguity inherent in the system as it stands? All of these are questions (among others) which we must ask of the neuropathologists' pictorial-descriptive system if we hope to understand or make use of it. All of them are questions we might be better prepared to answer (and ask) after a study of some simpler system such as the Nevada cattlebrands. If we plan to train some techniques drawn from linguistics onto these systems, it will not be inappropriate to apply these techniques first to a system which is relatively tractable to analysis, as a way, if nothing else, of sharpening our intuitions.

One further consideration, which I will only touch on here, is this: if for some reason we hope to extend and strengthen the neuropathologists' power of description, we may do well to have first studied the way in which some other system has augmented the descriptive power of English---even if, as in the case of the

brand-blazons, that augmentation consists entirely of compression ('A and E are combined' becoming 'A E Combined') and the creation of new terms (e.g. 'open').[2]

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2 Compression of description and the creation of special terminology, when not resulting purely from a love of jargon, serve of course to facilitate expression. Most professional terms can be satisfactorily defined in ordinary English, and these definitions could therefore in theory be substituted for the terms everywhere they are used, though at great cost in convenience. In some cases however such terms may be not a convenience but a necessity. For certainly it is easier for compactly-expressed descriptions to serve further expressive purposes: it is easier to form an "if...then" sentence with simple antecedants than with syntactically complex ones. (The dubious reader might try rephrasing "If two columnar arrangements of neurons embrace a dense group of astrocytes..." in everyday English or close to it, then completing the sentence with a "...then..." clause.) Plainly a limit is reached at some point, where a chain of reasoning which depends on complexly-stated antecedants and/or consequents surpasses the human ability to keep track of it. (It may be good English, but not usable English.) This claim may be taken as a particular version of the so-called principle of linguistic relativity, as put forward in references ((23)) or ((9)). (All references are to the list given at the end.) If we were to set about to further augment English for the neuropathologists' benefit, it would most probably be in the hope of further facilitating their expression of what they "see" in their pictures---perhaps with the bolder expectation that, freed from some hindrances to expression, they might actually "see" more than theretofore. A related use for 'augmented English' would be as a means of 'drawing the neuropathologist out': of enabling us to ask questions elicitative of more painstakingly detailed descriptions: of descriptions such as might be necessary to the 'understanding' of a computer, which as a pupil does not yet perform the contextual inferences which humans perform, and which therefore, as yet, demands more in the way of articulation.

By this time it may have occurred to many readers to ask why I am so interested in what the neuropathologist says he sees in the pictures he studies, rather than simply in the pictures themselves; and to ask also why I should be so interested in an "English characterization" of such complex pictures, when one could characterize them much more simply by laying a closely-knit grid over the picture and describing (as filled or non-filled) the contents of each small square thus formed. Both questions deserve answers.

First of all, it is foolish in a way to ask what are the "properties of the picture."[3] The neuropathologist can more fruitfully be thought of as imposing a structure on the picture, and of examining the properties of that interpretive structure. This will be clearer if we consider two additional facts. One is that the neuropathologist may offer the same description for a diagram such as Figure 2 presents, as for an actual brain-section on which the diagram was (partly) based.[4] That is, what is significant to him (under certain circumstances) is what is shared by the diagram and its corresponding section: we may think of him as (mentally) imposing such a diagram upon sections in the course of describing them. Secondly, it does no good to think of such

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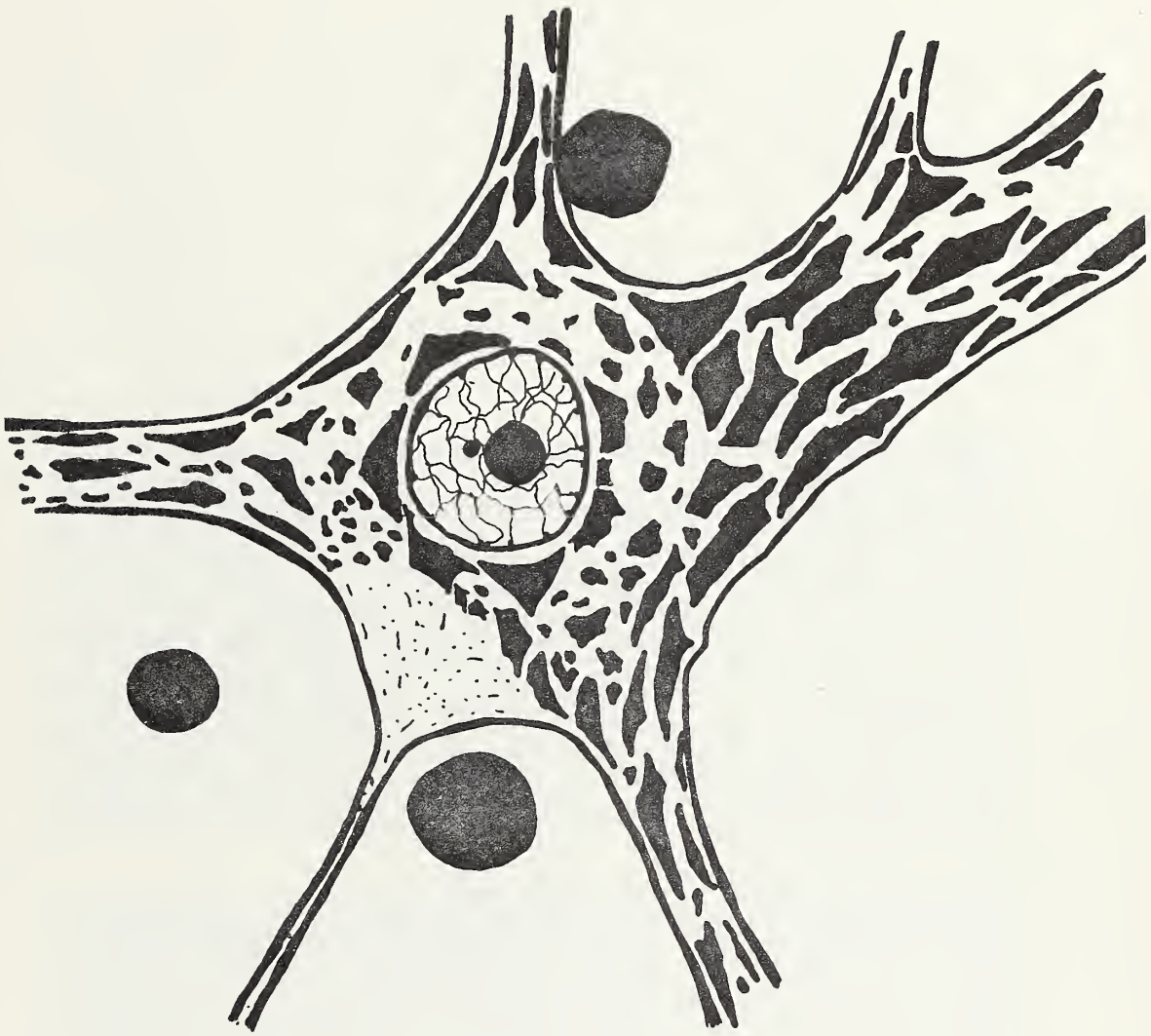
3 It was for this reason that I spoke earlier of "properties of the picture (so considered)".

4 Generally such diagrams are not based on any one picture, but on a set of such pictures (which is why I cannot show a section to correspond to Figure 2); the diagrams in effect are abstractions from such a set, showing as general properties what all of the pictures have in common.

FIGURE 2



a diagram as being "immanent" in the section, for the diagram is "immanent" only to a highly-trained neuropathologist. Both section and associated diagram might also be of interest to an art-critic; but he would not generally be expected to offer identical descriptions for them.

As for the proposal that we fit grids over these pictures, and exhaustively describe the contents of the small squares thus formed, this seemingly-attractive proposal must be placed in its proper perspective. Gridsquare-description is really only an expedient means of processing (or"addressing") pictorial sources, rather than a desiderated end of the analysis. There is no point, after all, in describing a single image so uniquely that its description has nothing in common with that of a second similar picture: yet this will almost inevitably be the effect if we identify pictorial characteristics by their (accidental) location on specified grid-coordinates; or measure the exact opacity of each square; or express with metric precision the distances between two opaque squares (or groups of opaque squares). All such characteristics are properties of that one image, relative to a particular superimposition of a particular grid. To belabor the point: the grid-based measurements of Figures 3 and 4, whose underlying images are neuropathologically identical, will be completely different if absolute location on the grid axes is considered.

That is to say, only by generous use of abstracting subroutines can we derive generality from grid-bound descriptions. Only, for example, by abstracting such qualities as "parallel to" or "near" from

coordinate-locations and metric distances; only by abstracting "relative opacity (or density)" from the specific opacity of particular squares. By the same token, since "opaque squares" do not figure as morphological units--are not the objects studied by neuropathologists--we must be able to label as e.g. "neurons" certain prescribed configurations of opaque squares, of whatever size, opacity, or grid-location; the interrelations we must end by describing are those which obtain among e.g. "neurons."

Thus, as we see, descriptive adequacy can be achieved only by surpassing the local grid-bound characteristics; these can serve only to 'read the image into the machine,' or to feed information into

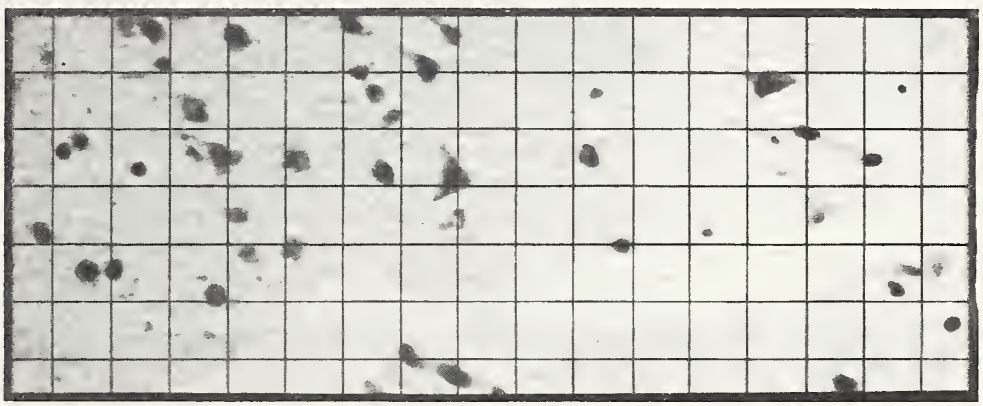


Figure 3

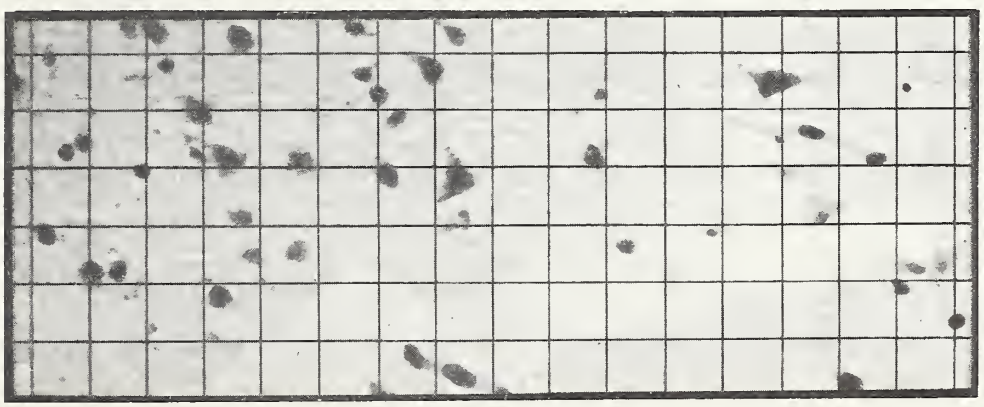


Figure 4

generalizing processors. It would be a serious mistake to rely for very long on specific measurements (of specific pictures) or on descriptions generalized no further than accounts of the pictorial relations obtaining among 'squares.'[5]

In sum, the neuropathologists' "characterization in English" offers the most convenient access to an understanding of how he interprets the brain-sections he inspects.[6]

The "professional dialect" used for the description of photomicrographs is a distinctive set of sentences, a distinctive proper subset of the set of all English sentences. As such, it can usefully be characterized by a grammar, similar except in size to the sort of grammar which might be used to characterize English itself.[7] A grammar for a "coherent fragment" of English, such as a "professional dialect" is, I have elsewhere called a "micrograммar."[8] A micrograммar, then, characterizes the sentence-set of its dialect most rigorously, and most compactly, when it "determines" that sentence set: when it is powerful enough to permit parsing with respect to it of any sentence from the

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5 See ((14)) for a "picture syntax" (something of a misnomer, I think) which is insufficiently generalized from grid-descriptions.

6 The most convenient access, but not the only one. For the pictures themselves can be manipulated, and neuropathologists' reactions to these manipulations gaged, so as to yield a further or confirmatory understanding. These techniques will be described in a subsequent paper; allusion is made to them in ((13)).

7 Except that English may contain syntactic structures which the dialectal micrograммar - or rather its model - would be inherently incapable of determining.

8 This usage originates in ((19)) and is further clarified in ((21)).

dialect, or better still when it is powerful enough to be used to generate any sentence. Such a "generative" grammar[9] can be designed so as to "determine" its sentences in a "linguistically proper" manner---instead of arbitrarily, as may be possible. Such a microgrammar with at least some elements of this last property, has in fact been built for a significant segment of the neuropathological dialect.[10]

A microgrammar might determine the set of sentences symbolized by "A _____is next to a _____," where the blanks can be filled by names for different cell-types, with the rules:

S = NAME B PREP NAME

B = * is*

PREP = * next to*

NAME = ARTICLE + CELLNAME

ARTICLE = * a*

CELLNAME = * neuron*

= * astrocyte*

= * microglial cell*

(and so on)

Here, we interpret the sign " = " as "is rewritten as," or "is

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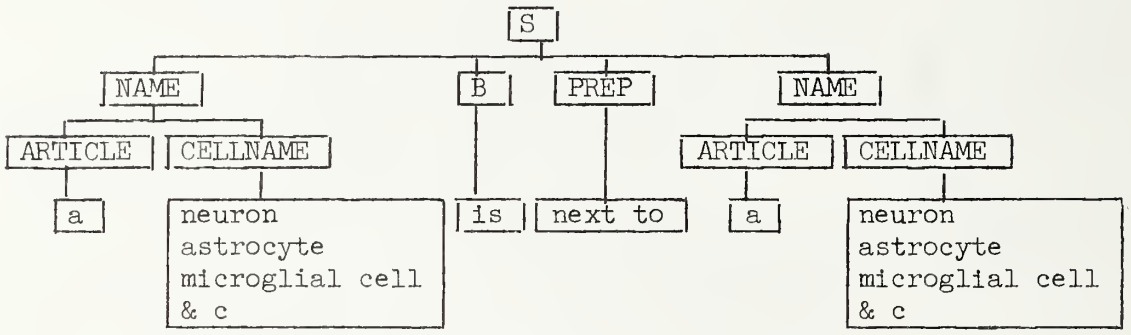
9 ((4)) remains the standard introduction to the concepts associated with "generative" grammars.

10 I refer to PLACEBO IV ((19)) and its successor PLACEBO V ((20)).

instantiated as;" and the sign "+" as "followed by."[11] Asterisks flank all terminals - i.e., all 'words' to be printed out in the generated sentences. This set of rules can be represented as a"tree":



Thus, by "proceeding down the replacive path," eventually one arrives at such sentences as "A neuron is next to a microglial cell." One also, of course, arrives at such sentences as "A astrocyte is next to a astrocyte;" but the rules could easily be improved to avoid this.[12]

In the same way, certain sets of pictures can be determined by a generative grammar; and, again, devising such a grammar may provide the best assurance of a penetrating, exhaustive, and germane analysis of that set of images. Suppose we want to generate pictures containing two cells which are three cell-widths apart. (We represent cells by

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11 This set of rules is in 'Thomas Normal Form,' rather than in the more conventional format; 'TNF' is the form used by the National Bureau of Standards micrograммar-processors described in ((5)).

12 Note that though this set of rules is too weak to generate only well-formed sentences, it is strong enough to parse well-formed sentences: though the parse, of course, would have only local validity.

diagrammatic shapes, and imagine all cells to be of the same size.)

We might devise the following 'grammar':

PICTURE = CELL + WIDTH-3 + CELL

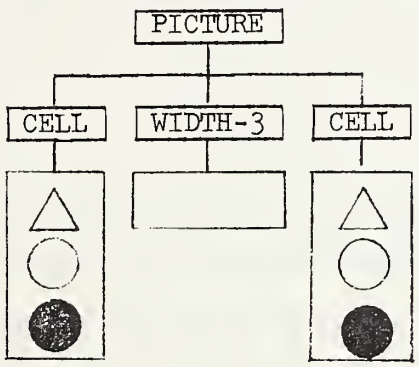
WIDTH+3 = * *

CELL =

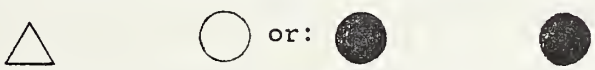
=

=

Or, in 'tree' format:



This 'grammar' will generate such pictures as:



So far, all "cells" will be aligned East-West, that is be on the same line; but we can easily change this. Instead of the single concatenative symbol "+," interpreted as "followed (on the right) by" we can use such concatenators as "R" ("followed on the Right by") and "B" ("followed Beneath by"). And, for that matter, by such additional concatenators as "NE" ("followed to the North-East by").

Thus the concept of "generative grammar" can be extended to include determining sets of rules for pictures. The "strings" of symbols (words) which linguistic grammars determine, can be generalized to "arrays"; "strings" are then seen as one-dimensional "arrays." In the end, we should succeed in deriving a somewhat more serious notion of "picture syntax."[13]

For a given set of pictures with associated descriptions, there may now be devised a linguistic grammar to determine the descriptions, and a pictorial (or "iconic") grammar to determine the pictures. The two grammars may be compared. It may be that the two grammars are very similar; it may be in fact that an isomorphism can be established between some of the rules in one and some of the rules in the other. If this possibility is present in a systematic way---I will not enlarge on this here---then we may call the two grammars "congruent."[14] If the two grammars are so congruent as to differ only in their "terminals"---the linguistic grammar ending by producing (analyzing) words, the iconic grammar ending by producing (analyzing) iconic elements---then we are presented with the opportunity of merging the two. That is, the same grammar may be used to generate both pictures and their

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13 The idea of this sort of determinative picture grammar was first broached in R. A. Kirsch's ((12)), extended and exemplified in the same author's ((13)). From this source, in the main, derive the notions behind the more highly-developed and more serious pictorial grammar which Rankin, Sillars, and Hsu have shown in ((16)). Rankin has since the appearance of ((16)) taken this analysis much further ((17)).

14 This term has been used, in essentially the same sense (of two rule-sharing natural languages), in Andreev's ((1)).

associated descriptions; and this in such a way as to properly associate with each picture its appropriate description.

It is just such a device as this that I will present in Section 3. There, the "pictures" will be cattlebrands, and the "descriptions," their blazons.

Such systems as brain-sections and their description, or cattle-brands and their blazons, may justly be labeled "covariant;" to vary the picture is to vary the description, and vice versa. Such covariant systems I will call "syndeictic" systems---each of the two components is syndeictic with respect to the other. The sort of grammar which generates both pictures and linguistic descriptions, I will call a syndeictic grammar.

Here again, we may feel that constructing a syndeictic grammar is the best way of strengthening the analysis---of making it, because more exhaustive and more explicit, more 'vulnerable.'

I have raised many problems here and treated only a few. More will be considered in the course of the ensuing description of the Nevada brands. Others will remain to be treated in other papers; both "iconics" and "syndeictics" are in their infancy, and it is reasonable to suppose that both disciplines will be greatly clarified and formalized during their coming development.

1. Iconics of the Nevada Cattlebrands.

We proceed now to the iconic morphology of the cattlebrands of Nevada.[15] My source for this set of brands is the 1961 edition of the Official Brand Book of the State of Nevada, a quinquennial publication of that State's Department of Agriculture; and also six of the semi-annual Supplements to the Book ((15)). The Brand Book proper, for each of the 3,168 brands there registered, lists the brand itself, e.g. ; as well as the owner for which the brand is registered, the Nevada counties in which registry is held, the earmarks which are generally registered (and used) together with the brand, the places on the animal's hide where the brand is to be put, and lastly the brand's reading, e.g. "Open A E Combined." There seems to be no generally-used term for these "readings," and so I have taken to calling them "blazons," a term drawn from heraldry.[16]

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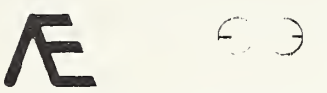
15 Though I adopt here the common usage "cattlebrands," I do so in the knowledge that it is not exactly accurate. "Livestock brands" would be better, for brands are generally registered, quoting the Nevada statute reprinted at the beginning of the Brand Book, for "all cattle or animals of the bovine species"; "all horses, mules, burros and asses or animals of the equine species"; and "all swine or animals of the porcine species." ('Chapter 564'; section '564.010'). Often the earmarks and placement of brand, but not generally the brand itself, differ according to which sort of animal is being marked.
It may be appropriate to explain why I chose to analyze the brands of Nevada rather than those of another cattle state. I did so because the Nevada brands are manageable in number; because the Supplements (which are very useful) were available to me; and as a tribute to my beloved Winnemucca and to certain ridges on a bend of the Humboldt a few miles east of Carlin.

16 For a discussion and exemplification of heraldic blazons, see e.g. ((3)). R. W. Hsu and I have started a syndeictic analysis of heraldry, but much work yet remains to be done on this project.

A typical entry in the Brand Book will look like this one:



Walter Irvin Leberski
El Co.
RTH LHC
Open A E Combined

The earmarks, too, could be subjected to iconic analysis; but since they are accorded no blazons, I have not been concerned with them here. The name of the owner, the counties of registry and the brand-location on the hide,[17] are also not relevant to our present interests, and will not be further treated.

1.1. Order-of-Blazonry.

The Brand Book itself provides the reader with an implicit set of rules for the order in which brands are read.[18] That is, since the Book is basically ordered alphabetically by brand, it is easy to establish which letter in a given brand has been taken as the initial letter, which as second, and so on. If oriented left-to-right, the leftmost letter is the one the brand is first alphabetized under: such brands are 'read' or blazoned from left to right, then. In the same

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17 In the above given registration, "El Co." stands for Elko County (in the Northeast corner of the State); "RTH" and "LHC" stand for Right Thigh Horses and Left Hip Cattle, respectively.

18 Since I have not been able to contact directly any of the owners of Nevada cattlebrands, the Brand Book and its Supplements have had to serve as virtually my only informant. It will thus be fitting to give, from time to time, brief notices of how the Brand Book has provided me with information over and above the individual brands and blazons.

way we learn that brands oriented North-South are read from North to South; and that brands which consist of one letter entirely inside another, are read from outside-in.

The rule that brands are 'read' from left to right, from top to bottom, and from outside in, is very strong: so strong in fact that the brand: which I think is obviously modeled on the famous Ford insigne, is blazoned as "8 V" rather than as "V 8," and classified under the '8's accordingly.[19]

However, as with most rules, the order-of-reading rules have exceptions; as with some rules, these contain a systematic ambiguity. The exceptions come about when the brand's charges are aligned from left to right and from bottom to top: that is, from Southwest to Northeast. Here, left-right is normally dominant, so that:

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19 Brands beginning with letters are ordered alphabetically in the Brand Book; these are followed by brands beginning with numerals, which are ordered 2...9. (Since in brands the numeral '1' is quite similar to the letter 'I', the two are treated as a single symbol, and alphabetized as 'I'.) These two sets are followed by those beginning with Bars (these will be exemplified below), Slashes, Quartercircles, Circles, Rafters, Triangles, Diamonds, Crosses, and Boxes. Thereafter come the brands beginning with "Miscellaneous" figures; an idea of how varied these are, and how arbitrary their ordering must be, is given in the list of figures given in Section 4. Naturally, if two brands have identical first-elements, they are sub-alphabetized by their second elements in accordance with the same ordering principle as above; and so on.

is blazoned as "J Slash G." This subrule does not always hold, however, under certain circumstances; we will consider such exceptions in due time.

(Hereafter, since brands are formed from many elements besides letters---"slashes" for example---I will refer to all such elements, including letters, by the general term "charges". This term, like "blazon," is drawn from heraldry.)

The systematic ambiguity comes about with brands which consist of one charge laid directly over another, e.g.

(47/2/4)[20] and (21/2/6)

These two brands consist of an 'L' and an 'H' with a second charge (an 'S' turned on its side) laid across. In the first, the sideways 'S' is dominant, and blazoned first; but in the second the 'H' is dominant. This difference exemplifies a "systematic ambiguity" because the system of blazoning brands depends on the placement of the charges---leftmost, topmost, outermost---and these criteria are not applicable here. A new criterion might be imposed, for example one which stipulated that 'upright' charges be blazoned first; but even

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20 That is, "page 47, column 2, entry 4."
Perhaps here is the place to note that the brands cited from the Brand Book are not generally given exactly as found there: that is, they have been "abstracted" a little. How much of this "abstraction" is justified, is a question which will be clarified during the remainder of this paper; but the question will be taken up specifically in Chapter 4, and in Appendix II many of the brands cited in these pages will be reproduced exactly as they appear in the Brand Book.

this criterion would not apply with such a brand as: [21]

Moreover, if we were to insist that in the two brands cited above the 'L' and 'H' are 'topmost,' in the sense of extending further North, any criterion derived in this way would fail for such brands as:

(62/1/5).

With this preamble, we are now ready to move on to a treatment of the various operations which alter charges and which combine them into brands.[22]

1.2. Rough Characterization of the Operations.

As used to form brands, charges may undergo various changes and may combine with other charges in various ways. Thus, though some

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21 This brand, though plausible-looking, is not among the Nevada registries. From here on, any brands given without a Brand Book identification (e.g. '62/1/5') will be ones which I have made up.

22 The information that brands are read from the left, North, or outside, can be obtained from a number of popular books about brands. (See the annotated bibliography of some of these works at the end of this paper.) Generally, however, I have found that these books 'clarify' the brand-systems by omitting exceptions to the over-simplified rules they propose: they are not very reliable, and I will scarcely refer to them further.

brands consist of just one unaltered charge, like:

(46/1/14)

it is far more common, if the brand consists of a single charge, for that charge to have been changed in some way---"operated on"---; and it is also more common for a brand to be formed from more than one charge.

A charge may acquire 'wings,' for example, as in:

(42/1/14)

or it may be inverted, as the 'T' is in:

(50/1/12)

On the other hand, when two charges (or more) are combined to form a brand, they may be simply juxtaposed, as in (50/1/12) just above; or they may be run together, or partly superimposed, as in:

(19/2/14)

One way of describing the changes in individual charges is, as suggested above, by showing what 'operations' can be performed on them---adding 'wings,' for example---; and it is equally convenient to describe the combination of charges as resulting from 'operations' on the charges involved. The operations on individual charges we may call

'unary' (operate on one thing); the operations which combine charges, we may then call 'multinary' (operate on more than one thing). Now, the 'unaries' are rather different from the 'multinaries,' in what they do as well as in the number of things they operate on: and I will describe them quite separately.

As I will show below, some unaries operate on whole brands instead of, or in addition to, operating on single charges; these operators are no less unary for that.

1.3. The Unary Operations.

The unary operators vary in the extent of the changes they make in a charge, but they also differ in a more significant respect. For it is possible to apply more than one unary operator to a single charge, but there are two kinds of restriction on such multiple applications: certain operations may not be used once certain others have been; and, in certain cases, if two operators are used they have an order-of-precedence: one must have been applied before, rather than after, the other. In consequence, there is a natural classification of the unary operators and a natural ordering to the classes. This ordering is used below in stating the classes and operators; its motivation will not be entirely clear, however, until the exposition which follows the description of operators.

1.3.1. Class-1 Unaries.

'1(CHARGE)'

Expressed above is a "functor-argument" formula which indicates the manner in which the class-1 operators function: they operate

directly on any charge subjected to them, without interposition of any other class of operators. (This comment will become clearer as we proceed through the operator-classes.)

There are three class-1 operators; these are "stretching," "enlarging," and "spreading." The first two of these operators may be applied once or twice; the third may be applied once, twice, or three times: multiple applications, of course, have a more far-reaching effect. A given charge may be subjected to any one of these class-1 operators, or to any combination of them; or the charge may be subjected to the influence of none of them. This state of affairs may be expressed in a simple formula:

$$1 = (STR''), (ENL''), (SPR''')$$
$$= \emptyset$$

That is, the class-1 operators are the three as given, each applicable as many times as there are "primes" (or apostrophes) following; the comma means "and/or" and indicates that any combination of one or more of these functors can be chosen. However, '1' may alternatively be '∅', or 'zero'---it may result in no change at all. (It is a little easier to state, in this way, its failure to operate, than to say the class-1 group is skipped entirely.)

1.3.1.1. STR'' ("stretching").

The STR'' operator has the effect of stretching, or lengthening, one line of a charge. The results of its application can be seen

most easily when the charge affected is the "Bar." This charge in its normal (unstretched) size can be seen in such brands as:

(11/2/7)

Upon one application of STR'' to "Bar," the charge is increased by a line one-half as long as itself---that is, is extended by 50%. An example is:

(52/2/3)

If applied twice, or rather twice-applied, STR'' increases the original line by adding two lines one-half as long as the original---that is, extends the original by 100%. The result of twice-applying STR'' may be seen in:

(11/2/4)

Note that the "Bar" of (52/2/3) is longer than that of (11/2/7) by half; and that the "Bar" of (11/2/4) is longer than that of (11/2/7) by a factor of two.

If STR'' is to be twice-applied, this is accomplished as one operation: a segment one-half as long as the line to be 'stretched' is measured off, and then two such segments are added. The twice-stretching operation is stated in this way for the sake of simplest

description of the operator: otherwise we would have to specify that STR'' in its first application extends a line by 50%, and in its second application extends a line (a line already increased by 50%) by 33%.[23]

STR'' is also occasionally applied to letter-charges. In such cases, STR'' extends only one line of the charge, and that the longest line (which must therefore be specified in the description of the 'basic' or 'primitive' charges). I know of no examples of double-

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23 STR'' is really a coalescence of two operators, which we might call STR* (extends by 50%) and STR** (extends by 100%). If I actually established two such operators, however, I would also have to establish constraints over their being both applied: for the result of such dual application to the same charge would be to extend the charge by 50% and then by 100%, for a total of 300% (e.g. from 1/2" to 3/4" to 1 1/2".) It is simpler, all things considered, to let a single operator be either once-applied or twice-applied, at least in the present treatment; for other purposes, such as introducing the brand-specifiers into a computer, it might be easier to dissolve STR'' into its components, as stated above, with provision for the constraint on dual application.
Alternatively, a contextual rule might be established, stating that STR'', applied to a charge already altered by a prior application of STR'', extends by only 33%, rather than 50%. These percentages can be stated exactly for 'idealized' brands, but of course this is no warranty that they will hold for actual brands in use. Still, 'idealization' is motivated by the belief that only non-distinctive differences are being obscured: that, in the case at hand, the replacement of a line-length in an actual brand by the closest of the three line-lengths producible by the rules listed here, would go unnoticed or would be found acceptable. If not, of course, STR'' could be modified accordingly.

application of STR'' to such charges; as an example of a single application, however, we have the 'Y' (but not the 'M') of:

(39/1/13)

Again, we have both the 'T' and the 'Y' of this brand:

(53/1/11).

In the latter case, the 'T' has been once-STRetched, while the 'Y' has been twice-STRetched.[24]

1.3.1.2. ENL'' (enlarging).

The ENL'' functor, which can also be either once-applied or twice-applied, magnifies whatever charge it is applied to, with no other alteration: it changes the dimensions of a charge, but not its proportions.

A single application of ENL'' makes the charge twice as large; a double application makes it three times as large. (That is, singly-

24 To derive (53/1/11) successfully, we must take as primitives a 'Y' the height of whose "stem" is equal to half its total height ---this is normal in any case---and a 'T' which is perhaps a trifle more spindly than the usual printed 'T'---but such 'T's are found elsewhere in the Brand Book, e.g. in (52/1/1).

applied ENL'' magnifies by 2X; doubly-applied, by 3X.) When ENL'' is twice-applied, as with double application of STR'', the alteration is made all at once.

A single ENL'' operation produces the enlargement exemplified by the 'F' in:

(15/2/14).

A double application of ENL'' produces a greatly out-sized charge, of course; unenlarged charges appearing in the same brand with a doubly-enlarged charge appear miniscule in comparison. Compare, for instance, the two 'V' charges (both laid on their side) to the doubly-enlarged 'H' of:

(57/1/13).

Here, it may reasonably be objected that the just-cited brand exhibits, not an enlargement of the 'H,' but rather an extreme reduction of the two 'V' charges. Certainly it is true that the 'H' is not three-times normal size. Note, however, that the 'F' of (15/2/14) is indeed larger than usual: so that adding a new 'reducing' operator to the system would still not eliminate the need for ENL''. For the sake of economical description, then, we may as well exploit ENL'' to the utmost, for this operator does produce at least the

relative dimensions of the 'H' and two 'Vs'; if necessary, a processor can be introduced late in the system to reduce all produced brands to some 'normative size,' if there is one.[25]

1.3.1.3. SPR''' (spreading).

The "spreading" operator, which may be once, doubly, or triply applied (being unique in this respect), has the effect of spreading the 'arms' or 'legs' of a charge. (It fails to apply unless the charge does have the proper appendages.) By 'legs,' of course, I refer to the two supporting lines of 'M,' for example; by 'arms,' the two rising lines of 'Y'.

The 'M' charge normally appears as in:

(39/1/10)

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25 There is no particular reason to believe that all brands (or branding-irons) are such that two brands containing the same number of charges have the same size, though obviously there are upper and lower limits. Such a 'processor' as was mentioned above might be convenient, however, to adjust all brands so as to have a size within rather narrow bounds. Such a 'processor' might be useful elsewhere, too, as we will see.

Upon a single application of SPR''', the legs of 'M' are spread 22 1/2° outward[26], yielding an altered charge as in:

(38/2/8)

Doubly applied, SPR''' spreads the legs by 45°, resulting in:

(39/2/8).

Triply applied, this operator produces the extreme 67 1/2° spreading seen in:

(39/1/5).

(In this last brand, the 'M' has also had 'wings' added to it, which additionally alters its appearance.)

With this, we close for the time being our treatment of the class -1 operators, and proceed to the next class.

1.3.2. Class-2 Unaries.

(2(1(CHARGE)))

The above formula indicates the manner of operation of the class-2 operators, relative to that of the class-1 operators: the class-2

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26 Again, these specific figures are ones of descriptive convenience. That is, I claim that there are only three distinctive (or contrastive) degrees of spreadness.

functors operate after the class-1 functors have already operated (on a given charge); and they may operate no matter what operations took place at the class-1 stage. In other words, there is no constraint whatever between operations at the class-1 stage---whether any or all of the class-1 functors operated---and operations at the class-2 stage. This point is important because it is valid for all of the formulaic characterizations given in this paper. The class-3 functors, for example will operate irrespective of what has happened at this class-2 stage.

There are six class-2 operators. These are "squaring" (SQR); "vertex-rounding," or "hipping" (HIP); "semi-squaring" (SSQ); "warping" (WRP); "rounding," or rather "convexing" (CVX); and lastly "concaving" (CCV).

With the class-1 functors, any combination of functors could be chosen, as I indicated by separating them in their sub-rule by the symbol ",", read "and/or." Class-2 functors differ in this respect; among these functors there are several constraints on co-occurrence, leading to a rather complicated sub-rule:

$$2 = \text{SQR}, \ \text{HIP} \ ; \ \text{HIP}'', \ (\text{CVX} \ ; \ \text{CCV}) \ ; \ \text{SSQ} \ ; \ \text{WRP}$$
$$= \emptyset$$

The subrule will not become clear until all of these functors have been described and their co-functioning set forth; however, some sort of initial explanation is in order. The symbol "," is to be interpreted as before, as "and/or." The new symbol ";" is to be interpreted as "or" (but not both). Parentheses must be used to set

off groups of functors which have internal co-occurrence constraints and also, as a group, external constraints. The subrule may be read as "At stage-2 we may choose SQR and/or HIP; or HIP'' and/or either CVX or CCV (but not both); or SSQ; or WRP; or nothing at all."

Note that again the set of operators includes the zero option, meaning that stage-2 can be passed through without there being any changes made to the charge being operated on.

An alternative formulation of the class-2 operators, which I find less satisfactory, is discussed below in 1.3.2.3.

1.3.2.1. SQR (squaring).

SQR can only be applied once. Its effect is that of 'squaring-off' a charge---of replacing all 'U'-curves by a rectangle with one line deleted, where the open side of the rectangle, of course, matches (is mapped onto) the open side of the 'U'-curve. Naturally, SQR if applied to a charge having no 'U'-curve, does not take effect.

Examples of the results of SQR are the 'S' charges in these two brands:

(46/2/2)

(47/2/10).[27]

27 Note that the 'S' charge in this brand has already been operated on, at stage-1, by the ENL'' functor: an example of a charge receiving two different operations at two different stages.

1.3.2.2. HIP and HIP'' ('hipping,' or vertex-rounding).

Both HIP and HIP'' round off the vertices of such 'pointed' charges as 'A,' 'M,' or 'V.' Once-applied, HIP'' has exactly the same effect as HIP: this is a mild rounding-off, or blunting, as in the 'A' of:

(1/1/14).

Another example is provided by the blunted 'M' in:

(37/2/5).

Twice-applied HIP'' results in a much more pronounced blunting; the curve which furnishes the blunting effect joins the lines forming the subject angle further from their meeting-point. Twice-applied HIP'' produces the 'A' and 'M' of these two brands:

(1/1/6)

(37/2/4).[28]

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28 The middle vertex of this 'M' is less blunted than the two outer ones, a phenomenon unaccounted-for by this set of rules, unless they are especially qualified to produce such cases. That is, as of now (37/2/4) is not producible by this iconic grammar; I have cited it as a partial example of the effects of HIP'' for ease of comparison between this functor (when twice-applied) and the similar HIP or once-applied HIP''.

HIP (but not HIP'') may operate after an application of SQR, as in the 'C' of:

(6/2/13).

HIP'' may also precede an application of CVX or CCV; this possibility will be considered following the discussion of these last-named operators.

1.3.2.3. SSQ (semi-squaring).

The rare SSQ operator has an effect somewhat like that brought about by SQR and HIP together, with two differences. First, SSQ blunts corners by 'clipping' them, rather than by rounding them; and secondly, HIP is a functor of more general capability. This statement cannot be based only on examples of SSQ and HIP found in the Brand Book, for that corpus yields only two examples of the former. It is based rather on an hypothesis concerning what is allowable. The question here is one of which corners of a charge may be blunted by which functor; all eligible ones or a subset of this set? HIP, plainly, can blunt all vertices, including the Northwest corner of 'P,' as in:

(43/1/5).

Now, one of the two examples of SSQ which the Brand Book offers is also that of a 'P'; both examples of SSQ are contained in the single brand:

(55/2/9).

Note that the 'P' has had two corners clipped, but not the third. If we disallow any such charge as:

then we cannot allow SSQ to follow SQR (as HIP does), merely clipping corners formed by a prior application of SQR, for the result of indiscriminate clipping would be, for 'P,' just the effect we have disallowed. SSQ, then, must be defined to operate as SQR does, except that the result brought about is, not an open square, but such a square with its two vertices 'clipped.'

Note that the restriction we have placed on SSQ also prevents exploiting the obvious similarity between this functor and HIP (or HIP''), as by insisting that SSQ always follow HIP: for the last-named functor, as just pointed out, blunts corners which we want SSQ to leave inviolate.

1.3.2.4. WRP (warping).

The very rare WRP functor bends the exterior lines of a charge convexly, the bend occurring at the midpoint or just below; no

rounding or 'blunting' takes place. A clear example is provided by:

(58/1/1);

a more distorted example is shown by the left side of the 'A' in:

(1/2/13)[29]

1.3.2.5. CVX (convexing).

The CVX functor is not unlike the WRP operator; except that CVX replaces the exterior lines of a charge by smooth curves gently bowing outward. An example is the 'W' charge in:

(61/1/7).

1.3.2.6. CCV (concaving).

CCV is the reverse of CVX; it is identical in effect to CVX except that its replacing curves bow inward. CCV is rather rare; one example of its operation is:

(1/1/3).

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29 This 'A' has been additionally distorted, by displacement of its cross-bar; this second distortion is not at issue here.

1.3.2.7. HIP'' with CVX and CCV.

In the brand (1/1/3), reproduced just above, CCV has followed a double-application of HIP''. Note, too, that in the example of CVX, (61/1/7), HIP'' has been once-applied. This might have been expected, from the standpoint of design: a charge already rounded by CCV or CVX, might look peculiar if its vertices were not also rounded by an application of HIP''. In fact, if restricted just to determining the brands in the given corpus, I would have reason to compel CCV and CVX always to occur with HIP''. However, such a brand as:

seems well-formed, and I have thus allowed its formation.

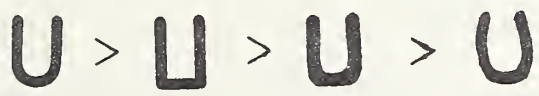
The rather complicated formulation of the stage-2 subrule has, I think, largely been justified in the foregoing presentation of the class-2 functors and discussion of their complex interrelationships. Recalling that formulation:

$$2 = \text{SQR}, \text{HIP}; \text{HIP}'', (\text{CVX} ; \text{CCV}); \text{SSQ} ; \text{WRP}$$
$$= \emptyset$$

We have seen SQR operate alone (1.3.2.1.), and prior to an application of HIP (1.3.2.2.). We have seen HIP operate alone (1.3.2.2.) and both SSQ (1.3.2.3.) and WRP (1.3.2.4.) alone. HIP'' has also been seen functioning alone, once applied (and equivalent to HIP) in the first examples of 1.3.2.2., and twice-applied in the second

pair of examples from that section. In this section 1.3.2.7. we have seen HIP'' twice-applied before CCV, and once-applied before CVX.

The complexly-stated formulation above, however, with its several co-occurrence constraints, has forbidden the formation of numerous otherwise-possible developments. Among these is one which bears mentioning: it is not possible to apply SQR, HIP or HIP'', and CVX all to the same charge; the following sequence of alterations is disallowed:



Here, it may be objected that there would be no harm in permitting this derivation, since the final product is well-formed. My reason for excluding such derivations---and a prime reason for stating the class-2 constraints in such detail---is only partly the fact that such a final product would appear just like (or enough like) an unaltered U---the original form of the 'U'---; though I think such an ambiguity is undesirable.[30] A more compelling reason must await exposition until we reach the discussion of the syndeictics of the Nevada brands.

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30 Not all ambiguities are avoided in this presentation: those which are judged inherent in the brands system, are of course included, as see below.

1.3.3. The Class-3 Unaries.

(3(2(1(CHARGE))))

As indicated, the class-3 operators apply to a charge already affected by the functors of classes 1 and 2; and, again, the class-3 functors apply no matter what earlier functors have attacked the charge.

With the class-3 functors we come to a set the co-occurrence constraints among whose members are much easier to define and state; they are conveyed by the formula:

$$3 = (BRK'', FND) \; ; \; BOX$$

$$= \emptyset$$

1.3.3.1. BRK'' (breaking).

The effect of the BRK'' functor is to break, or separate, two conjoining lines from each other. The degree of separation varies, but its range (for BRK'' whether once- or twice-applied) is indicated by these two brands:

(3/1/13)

and

"3/2/1"[31].

The degree of separation, then, can vary from a hardly-noticeable one to a degree so large as to make the original charge almost unrecognizable.

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31 I place this citation in quotes because I have reproduced only part of this brand, for the sake of clarity. The complete brand is reproduced in Appendix II.

I emphasize again that both degrees of separation (and all degrees in-between) are produced by both once- and twice-applied BRK''. The difference between a single and double application of this functor is not the degree of separation produced, but rather the place(s) where the breaks are made.

Once applied, BRK'' breaks apart only those lines converging at the most acute angle of the subject charge---or, if the charge has no angles, but does have curves, at the point of greatest change-of-curve. If two angles (or two points-of-greatest-change) are equally maximally acute, both are broken. Applied to a charge containing no curves, once-applied BRK'' produces an 'A' or a 'V' such as those of:

(3/2/6).

Applied to a charge containing no angles, but containing curves (typically in a charge whose angles have been blunted by HIPping), once-applied BRK'' produces such an 'A' as this:

(1/1/3).[32]

Once-applied BRK'' attacks curves only if the subject charge offers no angles. The normal 'P' charge, for example, contains

32 Obviously this 'A' has been more than HIPped; but only the HIPped apex is relevant here.

both angles and curves; once-applied BRK'' breaks only its angles. If the angles are equal, both are broken, as in:

(43/2/6).

On the other hand, if one of the angles is more acute than the other, only that one is broken, as witness:

(43/2/10).

(Note that both interior and exterior angles are judged as angles when ascertaining which angle is most acute.)

(Note also that the 'Y' of (43/2/6) contained both an angle (where the stem joins the bowl) and a curve (of the bowl); and that only the angle was broken.)

Twice-applied BRK'' makes all possible breaks: it breaks apart all angles in the charge, and in addition operates on any curves the charge may contain so as to break them at their point of greatest change-of-arc. A hipped 'A,' when not broken at all, will look like this:

(2/1/10).

Subjected to once applied BRK'', hipped 'A' takes this form:

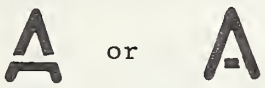
(2/1/9).

Subjected to twice-applied BRK'', the hipped 'A' changes to:

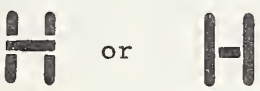
(1/1/1).

In the light of the above examples, it may be said that the most satisfactory way of describing the effect accomplished by BRK'' is not that it 'breaks apart' the lines involved, but rather that it deletes short portions of those lines; and I will let BRK'' stand as so defined.

A problem so far avoided is that of establishing which lines are to be partly deleted, in some charges: that is, where breaks are to be made when the foregoing rules fail to give an adequate indication of these locations. For, as so far stated, the subrules governing the operation of BRK'' do not always do this. In 'breaking' the 'most acute angle,' for example, as of now BRK'' produces either:



or either:



By the same token, any of these could, as of now, result from once-applying BRK'' to 'X':

but only the first three of these are found in the Brand Book; and I think only the first three are well-formed.

To solve these problems in a systematic way, I would have to specify the line-composition of each of the charges. Such a specification would permit, for example, the statement that deleting the end(s) of a line (e.g. the cross-bar of 'A') is to take precedence over interrupting a line (e.g. the diagonals of 'A') in the middle. However, such specifications enter into a level lower than that so far adhered to---into the morphophanemics, in fact[33]---and I have elected, rightly or wrongly, to focus this paper on the morphology of the Nevada brands. Thus the problem of where to break some of the charges will be met by indicating 'break-points' as part of the characterization of the charges themselves, in Appendix I. These marks may later be cast aside if the brands' morphophanemics is successfully described.

33 The term "morphophanemics" seems a fitting coinage, corresponding roughly to "morphophonemics", for the study of the way in which e.g. brand-charges are composed of their basic iconic elements. As to the word's etymology, one might as well cite the English morph "phan(e)" /feyn/, meaning something like "visible."

1.3.3.2. FND (finished, or seriffed).

The common FND functor adds serifs to the charge it is applied to, as in these brands:

(25/1/7)

(13/1/5)

(72/1/6)

(31/2/1)

or as also in this brand:

(73/1/4).

Two sorts of serifs are added by FND; however, these need not be individually specified, since the kind of serif to be added can be determined more generally.

A vertical line, or one oriented in a direction less than 45° from North-South, is seriffed by "crossing the T", i.e. by adjoining to it a serif extended a short distance on both sides: e.g. the 'J' in (31/2/1) just above. A horizontal line, however, receives either of two different serifs. First, it may receive a serif like that adjoined to vertical lines---but this only if the horizontal is not the charge's topmost or bottommost line: such a serif, for example, may be attached to the mid-bar of the 'E' charge, or to the corresponding horizontal of 'F.' On the other hand, this serif may be omitted entirely when applying FND to a charge: that is, when FND is applied, the attachment of a serif to a horizontal 'mid-bar' is optional. The second sort of serif which may be attached to a horizontal is like those adjoined to the top and bottom lines of the

'E' charges of (13/1/5), above. These do not "cross the T," but rather extend inward a short distance. Upon an application of FND, attaching 'in-bound' serifs to the appropriate horizontals, like attaching 'T-crossing' serifs to verticals and near-verticals, is mandatory.

As for the size of the serifs attached, this may vary greatly (though all attached to a given charge must be of the same dimension), as may be seen by comparing these two brands:

(12/2/11)

(23/2/14).[34]

The size of the serifs to be adjoined is optional within these two extremes.[35]

1.3.3.3. BOX (box).

The rare (two-brand) BOX functor produces the effect shown by the 'T' of:

(54/1/3).

---

34 Note that it is quite possible for a brand to contain both FND and unFND charges.

35 It may also be argued that there should be established an FND'' functor, which once-applied yields serifs toward the lower extreme, twice-applied producing serifs toward the higher extreme. I have not done this because the data available to me seem insufficient to warrant judging even whether the two extremes are contrastive (though they may well be), let alone what intermediate degrees are contrastive. In this case, also, the data do not seem to warrant extrapolation.

The effect may best be described as one of greatly thickening the lines of a charge, followed by evacuation (or chiseling-out) of all but the edges of those lines.

A somewhat similar effect may be observed in another brand, namely (61/2/11); but the latter seems deviant enough to justify excluding its form from those produced by the application of any of my listed functors.

1.3.4. The Class-4 Unaries.

(4(3(2(1(CHARGE)))))

The class-4 functors, like all the others, apply regardless of what functors have preceded in earlier classes. There are basically only two class-4 functors, Rev and Tbg''; but the latter is more conveniently treated as two functors, mutually exclusive. Thus:

4 = REV, (RTBG'' ; LTBG'')

= Ø

1.3.4.1. REV (reverse).

The Rev functor "reverses" a charge, with a result exemplified by the left-hand 'F' of this brand:

(16/1/12).

The operation may be described as one which rotates a charge, in three-dimensional space, through 180°; or, more simply, as one which replaced the charge by its mirror-image.

Rev is a rather common operator.

1.3.4.2. RTBG'' and LTBG'' (Right-Tumbling and Left-Tumbling).

The two TBG'' functors rotate a charge (on the page, this time) in clockwise or counterclockwise direction respectively, through 22-1/2° if once-applied, through 45° if twice-applied. Both TBG'' functors, once-applied, can be seen in this brand:

(19/2/12).

Twice-applied RTBG'' produces the effect shown by both 'H' and 'Bar' in this brand:

(22/2/14).[36]

A third degree of "tumbling", rotating the affected charge through 67-1/2° (or even more), might be postulated to account for the 'T' of this brand:

(53/2/11);

except that this brand appears in one of the Supplements to the Brand Book as having been produced just by twice-applied RTBG'':

(Supp.5/11/2/9).

36 This brand is ambiguous, however, in that the tumbling 'Bar' could equally-well be taken as an untumbled 'Slash'. See the discussion of the minor charges, and the remarks on ambiguity, for more on this question.

I have assumed, here, that the brand was corrected so as to accord with the more general degree of "tumbling"---i.e. that a contrastive degree of "tumbling" has disappeared from the Book, thus need not be accounted for. The alternative assumption, that (Supp.5/11/2/9) in fact reproduces (53/2/11) to the brand-owner's (and the Nevada Livestock Commission's) satisfaction, gives TBG'' more leeway than is common to these functors, thus seems less valid.

In future references to the two "tumbling" functors I will use the cover-term TBG'' except where to do so would be confusing.

1.3.5. The Class-5 Unaries.

(5(4(3(2(1(CHARGE))))))

Again, at stage-5, there are basically two functors, which are better treated as three:

5 = INV ; (RLZY ; LLZY)

= Ø

1.3.5.1. INV (inversion).

The INV functor rotates a charge through 180°: that is, turns it upside-down. Examples are numerous; two are found in:

(45/1/7)

(52/2/7).

1.3.5.2. RLZY and LLZY (Right-Lazy and Left-Lazy).

The two LZY functors, which rotate a charge through 90° in clockwise or counterclockwise direction respectively---turning a charge on either side---are probably the two most common of all the unary functors. Often, in fact, both are seen to have operated within the

same brand. Operating singly, the two LZY functors may be observed in:

(1/1/6)

and in:

(79/2/1).

As with the two "tumbling" functors, when it will not cause confusion I will refer to both LZY functors by the cover-term 'LZY'.

1.3.5.3. Ambiguities Involving INV and LZY.

Although in most respects INV and LZY are among the simplest functors to describe (or recognize), in one respect they are a little troublesome; for they are involved in the most pervasive kind of ambiguity to be found in the system of Nevada cattlebrands: namely, "violation of the Zambia Restrictions." (TBG'' also participates in this ambiguity, but to a much smaller extent). The Zambia Restrictions are a set of nominal constraints on charge-rotation, based on an aversion to needless ambiguity: for example, these restrictions should forbid the application of INV to the 'H' charge, or of INV or LZY to 'O', because generally the results of such applications are identical with the form of the charge prior to their attack. For another example, the application of INV to 'W' yields a charge very like an unaltered 'M' charge.

A full discussion of the so-called Zambia Restrictions, however, must await completion of more immediate tasks: listing and explaining the functors, the primitive charges, and above all the blazons and the syndeictic rules which unite all of these. Thus for now I mention these restrictions only in passing.

1.3.6. The Class-6 Unaries.

There are ten class-6 functors in all; with the exception of one mutually-compatible pair, they are mutually exclusive.

6 = FLG; WKG; RUN; RKG; RNG; (LDG,TRL); SKD; 4SK; 4WG

= Ø

It should probably be pointed out, in passing, that the reason for there being so many functors grouped under class-6 is not that a few were put off arbitrarily, only now being gotten around to: the reasons for the class-6 grouping are as cogent as those for any of the other groupings; but they cannot be explicated until more has been shown of the brands-system as a whole.

1.3.6.1. FLG (flying).

By far the most common of the class-6 functors is FLG, an operator which attaches "wings" to the charge it is applied to. The kinds of "wings" attached form a rather heterogeneous set; and the points on the various charges at which "wings" may be adjoined, are by no means uniform. To clarify this discussion, I will first exhibit some "winged" charges:

(1/1/8)[37] (5/1/1) (10/1/14) (19/2/5)

---

37 This brand is very like another brand which we must judge from the Brand Book to have been derived quite differently (namely, (59/2/1)); thus, (1/1/8) must be admitted as ambiguously derived. This question will be returned to below.

(37/2/6)

(40/1/10)

(41/1/11)

(42/1/14)

(6/2/14)

(96/1/3)

(27/1/4)

The above representative selection of FLG charges should be quite enough to demonstrate the main varieties of 'wings' and the range of adjunction sites. In all, at least seven types of 'wings' can be distinguished:

(1/1/8), (40/1/10), (41/1/11), (6/2/14)

(5/1/1), (27/1/4)

(10/1/14)

(19/2/5)

(37/2/6)

(42/1/14)

(96/1/3).

We may also distinguish two main sites of 'wing' adjunction: at or near the top, and at or near the mid-point; but further qualification is needed. "At or near the top" of the charge must be qualified to read "at or near the northeasternmost and northwesternmost points of the charge"; or, more precisely, "at the two outer intersections with the charge of a horizontal line drawn through the northeasternmost and/or northwesternmost points on the charge; or no further south of

this line than a distance equal to one-sixth the total height of the charge." This definition will hold for brands (5/1/1), (19/2/5), (37/2/6), (40/1/10), (42/1/14), (27/1/14), and (6/2/14). The prescription "at or near the mid-point" should also be qualified, to read: "at the (north/south) mid-point or no further from the mid-point, in either direction, than a distance equal to one-sixth the total height of the charge." This definition will hold for brands (1/1/8), (10/1/14), (41/1/11), and (96/1/3).

As for any covariance among the three variables (1) individual charge, (2) kind of 'wings,' and (3) placement of 'wings'---I see no reason in principle why any kind of 'wing' should be prevented from adjoining any charge at any of the allowed locations. Thus, the statement of the FLG functor is equivocal in this respect.[38]

1.3.6.2. WKG (walking).

The rare (though famous) WKG operator attaches a pair of 'legs' to the bottom of a charge, as to the LZY 'J' of:

(27/1/5).

---

38 The reader may have noticed that in some cases, e.g. (5/1/1), the 'wings' do not 'adjoin' the charge at all, but are as if "broken" away from the charge. Just this is the case, as will be taken up below as part of the treatment of the application of class-3 unaries to brands which have already undergone extensive alterations.

1.3.6.3. RUN (running).

The even rarer RUN operator attaches a pair of running 'legs' to the bottom of a charge, as in the one example:

(15/2/7).

1.3.6.4. RKG (rocking).

The RKG unary adjoins a 'rocker' to the bottom of a charge, as in:

(sup. 5/3/2/4)

1.3.6.5. RNG (running).

The RNG functor---not to be confused with the completely unlike RUN operator---is the single most complex functor of all the unaries, as will be manifest from a couple of examples of its effects. These may be seen in the 'M' of:

(57/2/13)

and in:

(59/1/10)

The general characteristics of RNG's effects are:

(a) Addition of a short 'leading' line to the leftmost line-end of the charge; and addition of a short 'trailing' line to the rightmost line-end;

(b) Hipping, or blunting, of all vertices; to which may also be added:

(c) a slight but noticeable 'lean' of all lines of the charge in an eastward direction. As may be seen by comparing (37/2/13) and (59/1/10), this last element is optional. The first two are not.[39]

Now, to be eligible for RNG to take effect, a charge must present a 'line-end' at both left and right limits---as 'M' and 'W' do. As I have explained above, the morphophanemics of the brands is not under view in this paper, so that the question of what 'lines' charges are composed of---and therefore the question of what 'line-ends' a charge contains, and where---is not being raised, in general. Thus, earlier, I served notice that special 'marks' were to be placed on primitive charges, as listed in Appendix I, in order to prescribe, for some charges, where BRK'' was to apply. The same step must be taken to prescribe 'line-ends' for the application of RNG: these must be 'marked;' and they are. The problem of establishing a charge's 'line-ends' could be solved generally, without recourse to morphophanemics, were it not for the fact that if a charge has already been operated on (at stage-3) by BRK'', it will present, when attacked by RNG, some actual 'line-ends' which RNG must ignore. And to distinguish these spurious 'line-ends' from the genuine ones requires a prior treatment of the line-composition of charges.

---

39 Quite a few charges are blazoned as "Running" which can have resulted from the application of functor (or sequence of functors) other than RNG---typically, an application of HIP''. In attempting to establish a distinctive RNG functor, these considerations of blazonage are not taken into account: though they will be, of course, in Section 3.

The operation of blunting the RNG charge's vertices has in effect already been described, under HIP.

The optional 'leaning' effect is another matter. We must describe the process which produces this effect as one which holds the bottom points (line-ends and vertices) still while the top ones are moved slightly (perhaps one-sixth to one-third of the charge's width) to the right. Such a definition is not wholly satisfactory, but, again, it avoids dipping into line-composition matters.

As now stated, RNG can take effect only on a charge which is listed (in Appendix I) with the requisite 'marks;' thus, for the present, we are freed from characterizing in detail what properties a charge must have to be subject to RNG. Still, it may be observed that the prime quality it must have is to present the 'end' of a vertical (or near-vertical) to left and right; the 'P' charge, for example, fails in this respect. Irrespective of what charges actually appear in the Brand Book as RNG, these I think must be said to be eligible for application of the RNG functor: 'A,' 'H,' 'K,' 'M,' 'N,' 'R,' 'U,' 'V,' 'W,' 'X,'[40] and 'Y.'

With regard to RNG, it must be remarked finally that the sort of 'leading' and 'trailing' lines to be added vary somewhat, but are generally speaking like those of (37/2/13): at least, there is probably no contrast between these and any others. Thus, these will serve as examples of such adjuncts.

---

40 Note that 'X' presents a pair of 'vertical or near-vertical' 'ends' to left and right---there should be two ways, then, of applying RNG to 'X.'

1.3.6.6. LDG (leading).

The LDG functor adjoins a short line just where the 'leading' line of RNG is adjoined; LDG may add a serif-like adjunct (but one which disobeys the rules governing use of FND); or a slightly curved variety of such a psuedo-serif. An example is provided by the 'U' of:

(55/2/2);

note that the small 'lead-in' cannot, by our definition, be a serif, since it fails to 'cross the T' of a vertical line.

1.3.6.7. TRL (trailing).

The TRL functor corresponds to LDG, adding a short serif-like component where the 'trailing' line of RNG is adjoined; one example is:

(56/2/12).

1.3.6.7.1. It may be noted here, in anticipation of the full treatment of ambiguity to follow, that if both LDG and TRL are invoked---or if RNG is invoked and the 'leaning' option not exercized---then the result will be a charge very like one operated upon by both HIP and FLG (with 'wings' like those of (19/2/5), say.)

1.3.6.8. SKD (spiked).

The rare SKD functor adds two short vertical lines ('spikes') to, roughly speaking, the topmost and bottommost points of a charge. More exactly, it does so only if the charge presents only one topmost point and one bottommost; but if the charge terminates at top and/or bottom

in a horizontal (straight or convex) line, then spikes may still be added to that charge, being adjoined to the top and bottom horizontal lines so as to overlay an axis drawn north-south through the center of the charge. Thus:

(46/2/2)

(46/2/3)

(18/1/10)

The above formulation forbids our adding 'spikes' to the 'A' charge, for example (i.e. SKD will fail to take effect), because 'A' does not have only one bottommost point. It may or may not be desirable that this formulation also allows us to add 'spikes' to a FND 'I' charge, resulting in a figure like a double dagger. On the other hand it is definitely not desirable that this formulation also permits adjunction of 'spikes' to an unFND 'I,' for the result of such application would be merely a long vertical line. Adopting a rule which will still permit formation of (46/2/3), let us stipulate that neither the topmost nor bottommost points of a charge subjected to SKD may be a terminus of a vertical line.

1.3.6.9. 4 SK (4-spiked).

Only one brand shows the effect of this functor, namely:

(46/2/4).

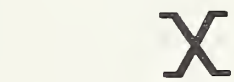
We may characterize 4SK as adding four 'spikes,' one at each of four points: Northwesternmost, Northeasternmost, Southeasternmost, and Southwesternmost.

1.3.6.10 4WG (4-winged).

The 4WG functor, also quite rare, adds short horizontal lines, rather like serifs but longer (and non-'T-crossing'), to charges having lines ending at the NW, NE, SE, and SW outermost limits of the charge. The susceptibility to 4WG is so greatly narrowed because 4WG is not only quite rare, but also, in my judgment, quite limited in regard to what charges it can legitimately operate on.

The two examples of 4WG which the Brand Book provides are these:

(19/2/6)


(61/2/10).

It might be fair to restrict 4WG to operating only on 'H' and 'X'---though in such a case it might be better to eliminate it entirely as a functor, adding the forms it would otherwise have brought about to the list of unaltered charges. However, it seems reasonable to suppose that:

would also be a reasonable brand; and perhaps 4WG could successfully be applied to 'M,' 'N,' and 'W,' as well as, with somewhat less success, to e.g. 'Z.' For this reason I have allowed 4WG a little more freedom than is prompted by the Brand Book strictly construed.

1.3.6.10.1. To make the foregoing expositions of 4SK and 4WG a little more precise, it should be additionally specified that 4SK adds 'spikes,' and 4WG 'wings,' only if no two of the four affected points---NWmost, NEmost, SEmost, and SWmost---coincide.

1.3.7. The Question of Order.

So far, the matter of what order (if any) the unary functors are to be applied in, has been left unspecified and unremarked-on, with one explicit exception. The exception is, as been noted several times, that the order-of-application class-by-class (of unary functors) is quite rigid, and proceeds in numerical order. Moreover, it has been stipulated that there is no constraint whatsoever across class-boundaries: that, for example, any class-4 functor can be applied irrespective of what class-3 functor has previously been applied. It follows that we can proceed through the classes choosing at random from the functors (and allowable combinations of functors); and that we can have chosen at least one functor from each class. Thus, choosing arbitrarily the first-listed functor of each class, and now instantiating the class-numbers in the formula with actual functor-names, and instantiating "CHARGE" with an actual charge---e.g. 'P'---we ought to derive a possible (though ugly perhaps) brand. The instantiated formula is:

(FLG(INV(REV(BRK''(SQR(STR''(P)))))))

Choosing (as we may) to once-apply both STR'' and BRK'', the resultant figure is:

My claim is that this figure, or altered charge, is well-formed: though it is not listed in the Brand Book (maybe for good reason).

A subsidiary claim can now be made: that when, in the process of instantiating a class-name, the choice is presented of choosing more than one functor (e.g. both BRK'' and FND): that those functors may be applied in any order, not just in the order listed. E.g. either BRK'' and then FND, or FND and then BRK''.

However, it is by no means claimed that it makes no difference which is applied first, in all cases. Consider the difference between an 'A' which is twice-BRK'' and then FND:

and an 'A' which is FND and then twice-BRK'':

The choice of order is free; but the choice can be significant.

Note, again, that the choice of order in applying REV and INV is not free: for the first is in class-4, while the second is in class-5. In this restriction lies one reason for the grouping of the unaries into six classes.

Other reasons for this grouping will appear in due time.

1.3.8. Omissions.

Not every observable effect that could be ascribed to the working of some unary, has been. Very restricted effects (e.g. applicable to only one charge), or very peculiar ones (rare and radically different) have not been included in my classifications. For example, the process

of removing the cross-bar from 'A,' leaving a figure identical to an inverted 'V'---this has not been included, for only 'A' seems to be eligible for this operation; "open A" is taken as a primitive charge. For another example, the "Bucking M" of:

(37/2/7)

has not been described as resulting from the application of a BKG functor---though it could have been---because such a BKG would be impossible to state for any charge but 'M,' so peculiar would it be and so unpredictable (given only the one example) would be its effects on other charges. That is, what should a "Bucking W" look like? I found that I was unable to say; hence, no BKG.

In the end, perhaps a general justification for my decisions along these lines can be stated: I have tried, throughout, to describe as fully as possible the systematic features of the Nevada cattlebrand iconics, at the (contextually defined) level of morphology. It may be that a few additional functors can profitably be added; but I suspect that the system, as described in these pages, will be able to accept them with small perturbation.

1.3.9. Higher Unary Applications.

Lastly, as has been suggested before, the unaries have not been completely described at this point of leaving them. For those of classes 3 and 6 may also operate after certain of the multinaries have had their effects. Thus, in Section 1.5., we must return briefly to these two classes, to show examples of these higher applications

and to show, too, why the effects there described cannot have resulted, or in some cases need not have resulted, from the primary applications just described.

1.4. The Multinary Functors.

1.4.1. Introduction.

We now come to the functors which combine charges into brands. These are, broadly speaking, those which juxtapose charges in one or another way; those which lay one charge across another (with superimposition only at one point of intersection); and those which wholly or partly superimpose a line of one charge on a line of another.

1.4.2. Maximum Number of Charges Per Brand.

A Nevada cattlebrand consists of at most four charges. Of these, no more than three may be "major charges"---letters, all numerals but "1," and some miscellaneous; the fourth must be a "minor charge," i.e. 'Bar,' 'Slash,' 'Quartercircle,' and 'Dot'; the numeral '1,' which in cattlebrands is generally identical to an upright 'Bar,' is also a "minor charge" in this sense.

The above-stated upper bounds on brand-complexity have been established in my system as general rules despite the presence in the Brand Book of five real or seeming exceptions to such rules. My reason for ignoring these exceptions is that all five appear to me to be "outside the system" in one sense or another. Of the two brands

which seem to have five charges, both prove on closer examination to be potentially reducible to fewer. The first of these:

(24/2/10)

is blazoned as "II Slash II", apparently to be pronounced as "/Roman/ Two Slash /Roman/ Two". That is, apparently 'II' is a single charge: thus (24/2/10) contains but three charges rather than five. The second 'five-charge' brand is:

(90/2/1).

This is blazoned as "Quartercircle L Double Bar G", i.e. as five charges; but on the other hand the "Double Bar" is identical in form with the "equals sign", and is placed with respect to 'L' and 'G' exactly where an "equals sign" would be placed in an algebraic expression. It seems possible, then, that this brand originally had the blazon "Quartercircle L Equals G", or some such: i.e. that it was originally regarded as being composed of four charges only. (With the fourth an allowable 'Quartercircle'.) So that there seem to be good reasons for ignoring this 'five charge' brand too, or for simply listing it as an anomaly. The three cases containing four major charges are peculiar in two other ways. All three brands manifestly contain four major charges---letters---; but all three consist of three letters combined, plus a fourth. (The meaning of "combined" in this contex will be made clear below.) But they share

a second even more striking attribute: all three occur in Supplements to the Brand Book, and only there: all three are new. ((Sup.3/3/1/2), (Sup.4/4/1/9), and (Sup.5/3/2/6) .) On this latter basis alone I would tend to regard these three brands as perhaps representing a new development in the history of brands, rather than general principles of the Nevada brands system as it stands now. Parenthetically, this decision is not motivated by a desire to simplify the rules presented here, for having to specify that the fourth charge of a four-charge brand must be "minor", in fact complicates those rules.

In the spirit of the abovestated restrictions, the following are well-formed brands: A, AB, ABC, ABC, 1001. The following are ill-formed: ABCD, ABC2, ///// ("Slash Slash Slash Slash Slash"). In addition, many of the miscellaneous charges show a marked disinclination to co-occur with more than one other charge, either major or minor: these "super charges," as I will call them, appear more complex and/or larger than the letter or numeral charges: and there seems to be an upper bound on the overall complexity of cattlebrands.

Two other elements add variety to the ways in which charges may be combined: both charges and groups of charges are subject to the multinaries; and charges or groups may be combined in any of five directions, or orientations. These points will be fleshed in the section which follows.

1.4.3. J (Juxtaposition).

The J functors (which differ only in the orientation they give the charges they are applied to) place one charge (or group of charges) next to another charge (or group)---or they may align as many as four charges all at once. 'Next to' in this sense means 'close to but not touching'; charges juxtaposed by a J functor are as if mounted on blocks, and the blocks juxtaposed: no part of a charge 'enters the block' of another. Thus,

cannot result from the application of a J multinary.[41]

There are five J functors:

JE- - -juxtaposes charges (or groups of charges) in West-East orientation (left-right);

JS- - -juxtaposes in North-South orientation (up-down);

JSE- - juxtaposes in Northwest-Southeast orientation;

JNE- - juxtaposes in Southwest-Northeast orientation;

JSW- - juxtaposes in Northeast-Southwest orientation.

Before continuing with the description of the J functors, it will be handy to contrive an abbreviation for the expression

"(6(5(4(3(2(1(CHARGE)))))))"

...for it is on the altered charge symbolized by this formula that the

---

41 These 'blocks' are very like the 'frames' used by Rankin, Sillars, and Hsu ((16)) for Chinese characters; these 'blocks' do not play nearly so important a role, however, as the 'frames' do: in fact, they could be omitted entirely with only a small loss in descriptive convenience.

multinaries generally operate. Let us more compactly represent this expression as "1-6CH".[42]

The juxtaposition of one "1-6CH" with another, in West-East fashion, I will express in the form

"JE (1-6CH/1-6CH)"[43]

Thus, if we now instantiate both occurrences of "1-6CH" in the above expression, we must expect to derive a well-formed brand. Let us instantiate the first "1-6CH", or (6(5(4(3(2(1(CHARGE))))))), as follows:

CHARGE = A

1 = Ø

2 = HIP

3 = Ø

4 = Ø

5 = INV

6 = Ø

Or, removing unneeded parentheses,

(INV(HIP(A))).

---

42 It is necessary to specify which unaries have already operated because, for some multinaries, only some may have operated.

43 Where "/" is used instead of the expected "," because "," has been used, in the unaries, in another connection.

The second instance of "1-6CH" we instantiate as:

CHARGE = R

1 = Ø

2 = Ø

3 = Ø

4 = REV

5 = INV

6 = FLG

Which yields:

(FLG(INV(REV(R)))).

Our instantiated juxtaposition phrase now reads:

JE ((INV(HIP(A))) / (FLG(INV(REV(R)))))

which yields the well-formed (if ugly) brand:

Examples from the Brand Book of each of the J functors, operating on two charges only, are:

JE:

(39/2/7)

JS:

(52/1/4)

JSE:

(27/1/7)

JNE:

(54/1/2)

JSW:

(22/2/14)

The relative frequency (in the Brand Book entries) of the above functors is in the order given. JE is extremely common; JSW is extremely rare.

We now pass to a listing of the several formulas which express the way in which the J multinaries operate. We note first of all that a brand may consist of only one 1-6CH: so that our first formula must be:

BRAND = 1-6CH

A brand may contain two major charges, or a super charge and either a major or a minor charge, or either a major or a minor charge together with a minor charge. Let us adopt the abbreviations mjch for "major charge," mnch for "minor charge," spch for "super charge",

mjmnch for "major or minor charge", and spmjch for"super or major charge." Then

BRAND = J (mjch/mjch) =a

= J (spch/mjmnch) =b

= J (mjmnch/mnch) =c

On the right, here, I have further named these formulas as a, b, and c, for ease of further reference; the above set of rules is equivalent to the set:

BRAND = a

= b

= c

a = J (mjch/mjch)

b = J (spch/mjmnch)

c = J (mjmnch/mnch)

A brand may consist of three major charges or of two minor or major charges plus a minor charge, or:

BRAND = J (mjch/mjch/mjch) = d

= J (mjmnch/mjmnch/mnch) = e

Or a brand may consist of four charges, where the first three may be either major or minor, but the fourth must be minor:

BRAND = J (mjmnch/mjmnch/mjmnch/mnch)

Note that in all of the above formulas, as in almost all of those which follow, we will not want the order of elements to be constrained: in formula e, for example, we will want the major and minor charges to occur, in the brands to be generated, in any order.

For example we would want "J (x/y)" to be equivalent to "J (y/x)". These formulas state the number and kind of elements being operated on, but not their order.

Let us now abbreviate "either a or c" as ac. Then, we note that either a major or a minor charge can co-occur with either a---the juxtaposition of two major charges---or c---the juxtaposition with a minor charge of either a major or a minor. So:

BRAND = J (mjmnch/ac)

Also, either a major or a minor charge may co-occur with e--- a minor charge and two other charges (either major or minor) juxtaposed---so that:

BRAND = J (mjmnch/e)

Also, the juxtaposition of three major charges (d) may co-occur with a minor charge:

BRAND = J (d/mnch)

And lastly, the juxtaposition of a minor charge with another charge either major or minor---c---may co-occur with either another c or with a (J(mjch/mjch); so:

BRAND = J (c/ac)

We may now state all of these formulas together, with some attention to consistency and completeness:

BRAND = 1-6CH

= a

= b

= c

```
          = d
          = e
          = J  (mjmnch/mjmnch/mjmnch/mnch)
          = J  (mjmnch/ac)
          = J  (mjmnch/e)
          = J  (d/mnch)
          = J  (c/ac)
ac        = a
          = c
a         = J  (mjch/mjch)
b         = J  (spch/mjmnch)
c         = J  (mjmnch/mnch)
d         = J  (mjch/mjch/mjch)
e         = J  (mjmnch/mjmnch/mnch)
mjmnch    = mjch
          = mnch
mjch      = major charge
mnch      = minor charge
spch      = super charge
J         = JE
          = JS
          = JSE
          = JNE
          = JSW
```

The categories mjch, mnch, and spch are then to be instantiated as 1-6mjch, 1-6mnch, and 1-6spch respectively; and these last three categories are further instantiated, as particular charges with particular unary alterations, in the lexical lists of Appendix I.

A couple of examples of these operations may be welcome.

J (mjmnch/ab) can be instantiated (reversing order) as

JS (a / mnch) can be instantiated as

JS ((JE(mjch/mjch))/ mnch) can be instantiated as

JS ((JE(1-6mjch/1-6mjch)) / 1-6mnch) can be instantiated as

JS ((JE(BRK''(HIP(A)))/(BRK''(G))) / STR''(BAR))

---which, when BRK'' is once-applied and STR'' is twice-applied, yields the brand:

(2/1/9).

J (c/ac) can go to

J (c/c) can go to

J(J(mjmnch/mnch)) / (J (mjmnch/mnch)) can go to

JSE((JSE(mjch/mnch)) /(JS (mjch/mnch))) can go to

JSE((JSE(1-6mjch/1-6mnch)) / (JS (1-6mjch/1-6mnch))) to

JSE((JSE(BRK''(L) / Slash))/(JS (BRK''(F) / Bar)))

which can be then immediately be instantiated as

JSE (L/) / (F) and finally as:

(37/1/8).

A consideration of the above two examples, and of the set of J rules, may serve to persuade the reader that the complexity of these rules is not needless: that, for example, adding the "Bar" to the south of 'F' alone, is far different in result from adding the "Bar" to the south of the other three charges taken together, as the "Bar" was added to south of 'A' and 'G' taken together in (2/1/9).

It may be objected at this point that it is 'F' alone, in (37/1/8), that is to the southeast of 'L/' --rather than 'F' --for a southeastern line drawn through the centers of 'L' and '/' would pass through the center of 'F', not through the center of the 'F' complex. This objection is well-taken; however, there are reasons for ignoring it. The strongest such reason is founded on the usual prejudice in favor of utmost simplicity of description: and it is extremely desirable that, for the level at which blazons are provided for brands, a single formulaic characterization of each brand be offered. With rules such as those called for just above, however, two formulas would be needed: one to juxtapose in a Southeast direction three charges 'L', '/', and 'F'; and another to juxtapose, in a Southward direction from 'F' alone, the '-' charge. Thus my prejudice in favor of simplicity, if nothing else, would probably induce me to ignore, for the moment at least, the aforecited objection. However, it must also be remarked that the objection itself may prove groundless, in either or both of two ways. For first it may be justifiable to conclude that the 'F' complex could have been placed such as to center on a line drawn through the centers of 'L' and

'/'---i.e., could have been thus sited with no contrast or no loss in acceptability to the brand-owner; and secondly, even if this proves untrue, it may be possible to get around the objection in either of two ways. Either a general requirement of uniform mutual proximity can be made---which would move the 'F', in any case, so as to be no closer to '/' than 'L' is---; or the '-' charge might go unused in such cases of charge-adjoining, being replaced by a '_' charge, which would underline a major charge leaving the 'center of gravity' of the complex thus produced unchanged from the 'center of gravity' of the non-underlined major charge.

All of these 'ways out' seem reasonable; any would meet the objection. Still, I stress once more that I have been led to consider these alternatives because of a well-motivated bias against characterizing brand-formation by more than one formula. Further work, and particularly more informant-work, will precede any revaluation of such decisions as the one under discussion; it seems fair, in the meantime, to warn where retraction or revision may be pending.

1.4.4. JI (Juxtaposition of Inclosure).

A sixth J functor, JI, must be segregated from the five preceding operators because of its pronounced peculiarities: not only in what it accomplishes, but also in what charge(s) it may attack.

JI so juxtaposes two charges as to have one inclose the other, or surround it. For example, the formula

JI ('circle' / S)

will arrange 'circle' and 'S' in this way:

(95/2/1)

Now, considering the opportunities for inclosure that can be found among the various charges, it is rather surprising how little-exploited JI is among the Nevada brands. For although in principle some of the letter charges---e.g. 'D' or 'P'---could inclose other charges, this never happens. Only super charges may inclose another charge: and of the super charges which would seem to be so eligible, the Brand Book shows only five. These are 'triangle', 'circle', 'flatiron', 'heart', and 'diamond.' To this list we might add at least 'box' as being apparently able to sustain JI.

JI has two other peculiarities. First, a brand never consists of both a super charge inclosing another charge, and of something else: the addition to (95/2/1), above, of an underlining bar, would make of this brand something different from anything found in the Brand Book. And secondly, only one charge may be inclosed by one of the six super charges, with but one exception: and this (96/2/11) is so deviant as to suggest that it be classed as an anomaly, outside the system proper.

It may also be remarked that in all probability most of the super charges (see Appendix I) are much too complex to be inclosed in a well-formed brand by 'circle' and its ilk. In fact, we might as well restrict the list of 'inclosable' super charges to that list which may inclose.

Lastly, we should note that the six 'inclosing' super charges may have already undergone attack by the unaries before they come to inclose another charge.[44]

Thus, our formulaic characterization of JI must read:

```
                BRAND  =  JI ( 1-6sixspch/1-5sixspchmjmnch )
          1-6sixspch   =  1-6 (sixspch)
             sixspch   =  'triangle'
                       =  'circle'
                       =  'flatiron'
                       =  'heart'
                       =  'diamond'
                       =  'box'
   1-5 sixspchmjmnch   =  1-5  (sixspchmjmnch)
       sixspchmjmnch   =  sixspch
                       =  mjmnch
```

(the remaining categories are instanced as before)

---

44 It seems best, however, to keep the inclosed charge at least from being subjected to the class-6 unaries.

An example of a super charge inclosing a letter has already been given, in (95/2/1) just above; there is no point in citing also an example of a super charge inclosing a minor charge. One of the six super charges inclosing another is found in:

(96/2/4)

The inclosing super charge has been altered by a unary, in this case FLG, in this brand:

(100/2/13)

1.4.5. N (Near-Juxtaposition).

As was explained above in 1.4.3, the usual J functors align charges next to each other "as if they were mounted on blocks"--- that is, an application of J never results in there being part of one charge "within another's domain": where by its "domain" I mean the area within a closed line joining all its outer points. For example, the formula JS (8 / V) produces the following brand:

where the '8' intrudes in no way into the domain of the 'V'.

However, the actual example of an up-down alignment of these two charges, as presented by the Brand Book, is:

(75/2/6),
(76)

where obviously the 'V' has been partly invaded, so to speak, by the '8'. Now, we can either assume that (75/2/6) and its more separated counterpart are not contrastive---so that we may ignore the "invasion" ---or we must provide another series of J-like functors. The disparity between "JS (8 / V)" and the actual (75/2/6) is so great that I have chosen the latter course: that is, I have assumed that close-proximity is contrastive.

As a first step, we may erect an NS functor to produce (75/2/6), from NS (8 / V).

We will then need an NE functor to produce e.g.

(7/2/4);

and in fact we may as well continue by matching each of the normal J functors with an N functor, completing the list then by NNE, NSE, and NSW.

Nothing else is needed to explicate the N functors, except that I might point out that as in

(39/2/8),

the essential mark of N's application is, not that the "invaded" charge embrace the invader---as 'V' and 'C' do in the above brands--- but only that the invading charge cross over the imaginary 'block' in which the invaded charge is sited. And I should also, before

giving the formulas which characterize the N class, remark that this class of functors would seem to be best restricted to operating on two charges only: the Brand Book shows no exception to this restriction, and a pile-up of near-juxtaposed charges would be rather ungainly.

Thus,

BRAND = N (1-6CH/1-6CH)

N = NE

= NS

= NSE

= NNE

= NSW

Finally, it must be remarked that there will be many cases, obviously, where an N functor will fail to operate: an expression "NE (N / N)", for example, cannot take effect.

1.4.6. T (Touching-Juxtaposition).

An extremely common form of juxtaposition is one which arranges charges so that they touch. An example is provided by:

(32/2/8),

in which the 'J' charge has been "connected", to the Northeast, to a 'cross' charge.

For (32/2/8) we will need a TNE functor; and again we may as well match each J (or N) functor with a corresponding T.

As for the question of how many charges may touch, the answer would seem to be, "as many as can be juxtaposed;" and in general it would seem that our formulaic representation of the T series can in this respect match that of the J series, for which reason I will not list the T functors separately at this time.

1.4.6.1 A Special Case of T.

Just as charges may be normally juxtaposed or "normally" touching, resulting from J or T, so also charges may be closely juxtaposed, with "invasion", as from N; or touching with "invasion", as in this brand:

(62/2/7).

(62/2/7) is different-enough in appearance to suggest that a new multinary be set up to account for it, NT say, for Near and Touching. However, a second look shows that such a new functor

would be inappropriate: the only way such an 'X' as is exhibited above could be lowered so as to touch the 'V' given above, would be exactly as in (62/2/7); this brand should result from a simple application of TS, then. For otherwise our hypothetical NT would apply just in those situations where T could not, and T where NT could not: T and NT would be in complementary distribution.

As it happens, NT would be a peculiar functor in any case, for its only occurrent variety would be NTS: there are only four brands in the Brand Book which display "invading" Touching, and all four are aligned North-South.[43]

1.4.6. A Further Restriction.

As presented above, the rules for T determine some obviously malformed or peculiar brands. As so far explained, TE, for example, could be successfully applied to two 'M' charges, presumably yielding this:

And TS could be successfully applied to two 'V' charges, yielding, perhaps, simply a 'V' of twice the usual thickness. Plainly both results, and all others like them, must be eliminated.

To do this in the simplest possible way, let us first introduce a notion of 'combining line', or 'face'; we will say that, with respect to T, the 'faces' of the affected charges are those lines or

---

[43] (7/2/12), (20/1/5), (32/2/4), and (62/2/7).

points which are brought into conjunction by the application of T. In applying TS to two 'V' charges, for instance , the 'faces' of both charges (if the two 'V's are of the same size) are both lines of each; in applying TE to equal-sized 'M' charges, the faces are the right 'leg' of the left charge and the right 'leg' of the left.

We now stipulate that if both faces are lines and are parallel, T will fail. Thus for example such formulas as "TE(M/M)" will not take effect. However we will allow for the successful application of T in cases where both faces are points terminating parallel lines, in order to provide for e.g.

(38/2/14).

The notion of 'faces' will also be useful in Section 1.4.7., which now follows.

1.4.7. C (Simple Combination).

We have already seen how charges may be placed next to each other, or "invadingly" close to each other; or be placed, in either way, so as to touch. The next step, that of partial superimposition, is also taken by the Nevada Brands, as witness the partially-superimposed 'H' and 'P' of:

(21/1/11).

Here again we will have recourse to a number of different C functors, each denoting the direction of alignment. Thus, the above-given (21/1/11) will be said to have resulted from the application to 'H' and 'P' of a CE functor; and in like manner we may establish the utility of other functors: CS, CSE, CNE, and (regrettably) CSW.[44]

Unfortunately, the C functors are involved in several problems, problems which typically demand, for their best solution, a plunge into morphophanemics. Since we will not take that plunge in this paper, we must content ourselves, for the time being, with only an approximate characterization of some of the effects produced by the C operators.

The application to two charges of a C multinary has a result akin to drawing the charges together until their nearest lines overlap. A glance at (21/1/11), just above, will persuade even the most captious, I think, that this description will hold for that brand; and it will hold for very many others. But by itself it is not enough, or rather is too misleading. For example, suppose we ask what happens when two charges are such that the number of "nearest lines" is more than two; suppose we want to apply CS to two 'H' charges. Immediately

---

[44] "Regrettably" because the NE/SW ambiguity thus reappears among the C functors.

there are problems. What should the result look like:

this? this? or this?

One way out of this quandary is to specify that the face of one charge must be completely absorbed by the face of the other: the first two of the above pseudo-brands would thus be disallowed, but the third preserved. But preservation of the third ought to be exactly what we do not want, for it is far from giving the appearance of two 'H' charges; and what's more, we would also be disallowing such brands as:

(20/1/2),

(which would seem to have resulted straightforwardly from an application of CNE), simply because neither 'H' nor 'B' has its face completely overlapped by the face of the other. Let us withdraw from this line of argument, and consider another: let us suggest that "only the 'nearest faces' may overlap, but no others". Such a proscription removes the third pseudo-brand from the list, for there the connecting-bars of the two (assumed overlapping) 'H' charges also overlap; but on the other hand this rule leaves as eligible brands exactly the ones which look worst, the first and second. This too must be abandoned. In fine, the way to reject all three "CE (H / H)" pseudo-brands, while keeping (20/1/2), is to specify that overlap of faces may be complete or partial; but that the two charges to be 'simply

combined' must offer, when aligned in the direction specified by the particular C functor involved, exactly one face each. It follows that no application of CS to two unadorned 'H' charges can take effect. While, on the other hand, the application to two 'H' charges of CE produces:

(20/2/3).

The cases of C-application presented above have all been uncomplicated enough---in (21/1/11), (20/1/2), and (20/2/3), charges were Combined which, when brought next to each other, presented parallel 'faces'. However, two charges need not face each other in this way in order to be successfully attacked by a C functor, as witness:

(1/2/11).

In this brand, the 'A' and 'D' charges could not be parallel when brought together (on an East-West orientation) so as to touch; and the result was that the 'D' was rotated toward the 'A' in such a way as to bring about parallelism. In fact, as is obvious, only by such a rotation could 'A' and 'D' be successfully joined by CE. Note too in (12/2/5):

that the REV 'E' has rotated to be parallel to the 'A'; but that in this case the rotated charge was to the left, rather than to the right. Note however that in

(2/2/6)

both 'A' and 'K' charges have been rotated---an equal amount---so as to be parallel. (The 'K' has also been distorted a little.) On the other hand, I have not succeeded in finding any cases where the 'A' alone was rotated. So that we may tentatively conclude that:

If two charges, when 'brought together', do not present parallel 'combining lines,' but if they diverge by less than 45°, then either the charge presenting the vertical face is held still while the other is rotated so as to present a parallel face (resulting in the superimposition or merger of the two faces); or else both charges are rotated equally until their faces are parallel and merged.

We next ask what happens when CE, for example, is applied to 'H' and (unFND) 'I'---and are compelled to reply that, evidently, the only result can be the complete absorption by the 'H' of the 'I'. In fact 'I' must be absorbed when bound by CE to any charge; so must 'l'; so must LZY 'bar', or a 'slash' which has undergone TBG so as to be vertical; or a 'slash' parallel to the right or left edge of 'W', and so on. We must eliminate such possibilities with a general rule, one which stipulates that:

If the application of a C functor to any two charges results in the complete absorption of that charge, the application is not to take effect.

(Note that this rule still allows for the success of e.g. CNE (H / I), for the 'I' will only half-overlap the right face of the 'H'; this loophole may or may not be desirable, but perhaps it should be left in as having possible propriety.)

We now ask what may have already happened to a charge before it is subjected to a C functor: that is, what unaries may have been applied.

No harm can be done by allowing such charges to have been altered at stage-1; if, say, a 'W' has been too spread to answer to the description 'presents a face no more than 45° from the vertical', then CE will simply fail, as specified, to bind such a 'W' to e.g. an 'H'. Nor does there seem to be any harm in letting one of the stage-2 unaries to have operated. On the other hand, if we have permitted FND to have operated, we will have raised problems; for how shall we apply CE to (FND(J)) / (REV(FND(J))) ? What do we expect to get:

this? or this?

No; it would be better if we sidestepped such problems (and the Brand Book does not forbid us to) by preventing any charge to which a C functor is to be applied from having undergone stage-3. (This is

a more general proscription than the one, concerning line-termini, which follows.) To continue: both stage-4 and stage-5 look safe enough, as quite a few examples from the Book testify; but the class-6 unaries, again, look dangerous. How should we expect a CE joining of two FIG 'H' charges to look? How Combine RKG charges? In the case of the class-6 unaries, too, we have reason to proscribe entry for charges which are to be subjected to C.

We now return to the notion of 'faces' for a moment in order to issue a last restriction: if two charges undergoing C both present points (line-termini) as 'faces,' then C fails; but if one presents a line-terminus and the other a line, and if either the line itself or the line whose terminus is a 'face' can be rotated (through 45° or less) so that the two are perpendicular---or if both can be made perpendicular by being rotated equally through a total of 45° or less---or if the two are perpendicular to start with---then C will be successfully applied. In this way such brands as

(20/2/14)

may result from C.

Finally, we observe that any of the C functors, within the many restrictions stated, can apply to three charges as well as to only two.

Thus,

BRAND = C (1245mjmnch / 1245mjmnch)

= C (1245mjmnch / 1245mjmnch / 1245mjmnch)

1245mjmnch = 1245(mjmnch)

mjmnch = mjch

= mnch

(and so on)

C = CE

= CS

= CSE

= CNE

= CSW

1.4.7.1. Partial Complementarity Between C and T.

The reader will have already noticed that there is a partial complementarity between C and T: by and large, the sort of charges which T may be successfully applied to, is exactly the sort of charges which C may not be successfully applied to; and vice versa. The complementarity is not complete, however---(20/2/14) can be produced by both---so that the possibility of merging these two functors is vitiated. This is not to say, of course, that the degree of complementarity that is present, is without significance as a characterizing feature of the set of charges and the set of functors.

1.4.8. D (Distortive Combination).

A rarely-used kind of combination is one which, in bringing two 'faces' into parallel, rotates one of the faces without rotating the rest of the charge, thus slightly distorting that charge. An example of the operation of a Distortive functor is provided by:

(2/1/1).

Here, the 'E' charge has been wrenched out of shape by the action of DE, which has rotated the face of 'E' to parallel the face of 'A', while the other three lines of 'E' have only been dragged along, as it were, to keep up with the rotating face.

Note that:

would also appear to be well-formed, and also, most simply considered, to result from an application of DE; however, this pseudo-brand and (2/1/1) are quite different in appearance. It will be desirable then to indicate, in expressions involving D functors, which charge is to be distorted and which dominant.

I will adopt for this purpose a notation exemplified by the expression:

DE (#1245mjmnch# / 1245mjmnch)

...where the symbol flanked by '#' will denote the dominant charge. It is evident that where a D functor has been applied to three charges, it can only be the center charge that is dominant: our expression must specify this, and must specify that in expressions involving D, the order of elements is fixed. So that:

BRAND = D (#1245mjmnch# / 1245mjmnch)

= D (1245mjmnch / #1245mjmnch#)

= D (1245mjmnch / #1245mjmnch# / 1245mjmnch)

This done, we allow D to be instantiated as expected:

D = DE

= DS

= DSE

= DNE

= DSW

We have thus provided for such cases as (2/1/1), cited just above, and even for such cases as

(53/1/5)

(disregarding the 'Bar' for the moment) where three charges ('T', 'V', 'T') are Distortively combined under the dominance of the middle one.

However, the 'distortions' to be found in combinations of charges are not only of the kind so far discussed, where a charge has been reshaped because its face alone was rotated. Another sort of

distortion comes about, not when the two faces are misoriented, but when they are otherwise dissimilar. The only example of this dissimilarity which I will treat here is one where one of the faces is a straight line, the other a convex one, as when 'O' faces 'K' to its right; witness:

(41/2/4).

Here, 'O' is dominant and the face of the 'K', in being combined with the face of the 'O', has had to be severely rounded. Thus the D functors permit superimposition of lines which could not be superimposed by the action of any simple C operator.

C requires that faces be superimposible, with or without rotation of one or both charges under attack; D does not rotate, but operates on charges whose faces (a) could not otherwise be superimposed without rotation; or (b) could not otherwise be superimposed even with rotation. In case (b), D operates on charges which C could not take effect on: whereas in case (a), D operates on charges which C could operate on, with charge-rotation needed. On the other hand, C operates in some cases where D could have no application: where faces can be superimposed without rotation and without any wrenching of lines; but C, of course, also operates in some cases where D could also be brought into play. Thus, there is partial complementarity between C and D---those cases where only one or the other could operate---and partial contrast---those cases where either could

operate, with different results. Such cases of incomplete disjunction are familiar from linguistics; they always require some explaining, but it is often difficult to make them disappear. In our case, for example, we could change the D functor so that it never conflicted with C, by inventing a new "Wrenching" functor, W say, to wrench charges which C could also have attacked, but without wrenching. Or we could change D so that it always conflicted with C---always attacked charges C could attack---by contriving a new "extra-distorting" functor, X say, to attack such pairs as 'O' and 'K'. But neither of these solutions is particularly attractive: so things may as well be left as they are, at least for the present.

Among the things one would want to reexamine in any future fresh treatment of the Nevada Cattlebrands, the problem of super-imposition - vs - distortion certainly stands out. In such a fresh treatment, perhaps D would be revised, in either of the two directions sketched just above; and such a new D, then, might also be made to perform one or two other minor operations which at present have been omitted from consideration. But this must await another time.

1.4.9. A (Athwart).

A, last of the functor-classes to be treated, lays one charge across (or, to use a distinctive term, athwart) another charge. The overlaid charge is generally centered on the underlying one: but not invariably. When the two Athwart charges are centered, we will

say that this results from an application of an AC functor. AC may be seen in these two brands:

(62/1/5)

(1/2/8)

If not centered on the underlying charge, the overlay is off-center in one or another direction. An example, which results from AS, is:

(7/1/3).

We might view the above brand as having come about from moving the 'A' up from the South, across the boundary of the 'C', until its movement was halted by the meeting of two faces: two lines of the affected charges which are most closely in parallel. As in the case of (7/1/3), these two faces are then superimposed, with or without wrenching depending on the circumstances; AS then may have an effect either like that of C or like that of D. But which effect is to take place is predictable from the nature of the charges involved. A (except for AC) may now be seen to resemble C and D rather closely: the main difference is that when a directional A is brought into play, AS for example, one of the faces will be in the interior of a charge.

This said, we may proceed to examine two other directional A functors: ASW and ASE, which result respectively in:

(30/1/13)

(52/1/1)

It must now be said that results of any of the A functors are quite rare. ASW is represented by but one brand in the Brand Book; and the Book offers no examples at all of AE or ANE, which must therefore remain hypothetical.

Due to the paucity of examples, it is impossible to have a very exact idea of what charge-pairs are open to attack by an A functor. Are they all? Yet the result of laying a LZY 'N' across an upright 'N' would surely be rather awkward; many other odd consequences can be forseen. Still, without delving into morphophanemics, and without having an opportunity to study the reactions of informants, it seems best not to issue wholesale restrictions in an effort to reduce the complexity or oddness of A brands. Of course it will be necessary again to specify that if the application of a given A functor to two charges results in the complete 'disappearance' of one charge, such an application is to fail.

It should be obvious, from the examples given above, that whether two A's charges are to be centered or to occur in e.g. Southerly alignment, is not predictable from the nature of the charges: hence the directions are in contrast, and the various A functors cannot be collapsed into one. This judgment is confirmed all the more by the

considerations taken up in 3.1.2.7., below.

1.4.9.1.

The openness of charges to attack by A would seem to imply that A would best be allowed to attack any two charges, no matter what unaries had already applied. What problems are thus raised---e.g. with BRK''---will be no more serious here than elsewhere; and so we will permit A this maximal latitude.

1.4.9.2.

The preceding treatment has ignored one brand,

(49/2/2)

because it seems unique in its formation and also because it bears a peculiar blazon, as seen below.

1.4.10. Summary and Generalization of the Multinary Functors.

We have now covered all of the multinary functors individually[45]; we can proceed to consider them as a unified system. For it is not enough to produce Juxtapostion, Combination, Athwartness, and so on, in isolation: a brand may use more than one multinary, as witness:

(53/1/5)

---

[45] That is, all of the multinary functors which iconic studies alone force us to consider. This somewhat gnomic disavowal will be clarified in Section 3.

...which uses both Distortive combination and Juxtaposition; or as witness:

(52/1/1)

...which uses both Combination and Athwart.

Thus, it is necessary to gather together our scattered descriptions into one coherent system which expresses all of the combinatory possibilities open to the Nevada Cattlebrands.

Returning for a moment to Section 1.4.3., let us withdraw for scrutiny the expression:

$$\lceil \text{BRAND} = \rfloor \; J\ (\text{mjmnch} \,/\, \text{ac})$$

which may be expanded as

$$J\ (\text{mjmnch} \,/\, \text{a})$$

$$J\ (\text{mjmnch} \,/\, \text{c})$$

where these two expressions are to be expanded respectively as

$$J\ (\text{mjmnch}/\ (J(\text{mjch}/\text{mjch}))\ )$$

$$J\ (\text{mjmnch}/\ (J(\text{mjmnch}/\text{mnch}))\ )$$

which expressions, in turn, govern the application of a Juxtapostion functor to a major or minor charge plus the juxtaposition of two major charges; and the application of a J functor to a major or minor charge plus the juxtaposition of either a major or minor charge and a minor charge.

Now, as we have just noted, a major or minor charge can also be juxtaposed to a Combination of, say, two major charges; or to a Dominating-combination of such charges; or to a T or presumably even A of such charges. Thus the symbol 'a', and equally the symbol 'c', can now be broadened to include all of the ways in which two charges may be joined so as still to permit their juxtaposition to a third charge.

We must first note, however, that there are two different kinds of "unaried" charges which the various multinaries operate on: the kind denoted by the expression "1-6CH" and that denoted by "1234CH". The multinaries J, N, T, and A all operate on charges previously attacked by any permitted sequence of unaries, from classes 1 through 6; but the superimpositional multinaries C and D affect only charges which have been subjected to unaries of classes 1, 2, 4 and 5---but not 3 or 6. This must be taken into consideration when generalizing over the multinary functors.

Let us adopt the cover symbol L (Linking) for J, N, T, and A; and, the cover symbol S (Superimpositional) for C and D.

Then we may restate the symbol 'a' in this way:

a = L (mjch/mjch)

= S (1245mjch / 1245mjch)

where, as before, the symbol "mjch" is to be instantiated as "1-6mjch" and where the intended instantiation of "1245mjch" is obvious;

and we may restate the symbol 'c' in this way:

c = L (mjmnch / mnch)

= S (1245mjmnch / 1245mnch)

where "mjmnch" is to be instantiated as "1-6mjch" or "1-6mnch" and where again the symbol "1245mjmnch" has the obvious interpretation.[46]

Again drawing upon Section 1.4.3, let us consider the symbol 'b':

b = J (spch/mjmnch)

which we restate as:

b = L (1-6spch / mjmnch)

= S (1245spch / 1245mjmnch)

with the obvious intended interpretations.

We proceed to consider symbols 'd' and 'e':

d = J (mjch/mjch/mjch)

e = J (mjmnch/mjmnch/mnch)

Obviously whatever cover-symbol we replace J with must be instantiable only as functors which can have as many as three arguments. Now, both S functors can have as many as three; but of the L functors, only J, T, and N can.[47] Let us adopt the cover symbol JTN for these three multinaries. Then:

d = JTN (mjch/mjch/mjch)

= S (1245mjch/1245mjch/1245mjch)

---

[46] The JI multinary has been omitted from both L and S cover-symbols because it is so limited in its domain of operation that it is better treated separately.

[47] T can have three; J and N can have four.

and:

e = JTN (mjmnch/mjmnch/mnch)

= S (1245mjmnch/1245mjmnch/1245mnch)

To provide the last measure of flexibility, we now insure that we include appropriate cases in which, where one of the Linking functors operates on three charges, those three can consist of either three charges in simple sequence (e.g. "mjch/mjch/mjch") or of one of those charges plus the other two yoked by some permissible functor (e.g. "mjch/L(mjch/mjch)"). We do this by adding a new instance to the set of 'd' instances:

d = JTN (a/mjch)

and by adding two new instances to the set of 'e' instances:

e = JTN (mjmnch/c)

= JTN (mnch/f)

where

f = S (1245mjmnch/#1245mjmnch#)

= S (#1245mjmnch#/1245mjmnch)

We are now about to merge all of these rules into a unified system; but before doing so it is necessary to point out that, in expressions involving the D functor, the "dominant" charge must be denoted. Since this "dominance" plays a role in no operations but those involving D however, we are free to include a "dominance" indication in expressions including functors other than D: these indications lie fallow unless the cover-symbol is instantiated as D.

We may also, at this point, form a general rule that in functor expressions any permutation of arguments is permitted except when the arguments are flanked by the "dominance" indicator "#"; these are fixed. Then

BRAND = 1-6CH

= a

= b

= c

= d

= e

= J (mjmnch/mjmnch/mjmnch/mnch)

= J (mjmnch/ac)

= J (mjmnch/e)

= J (d/mnch)

= J (c/ac)

= JI (1-6sixspch/1-5sixspchmjmnch)

ac = a

= c

a = L (mjch/mjch)

= S (#1245mjch#/1245mjch)

= S (1245mjch/#1245mjch#)

b = L (1-6spch/mjmnch)

= S (#1245spch#/1245mjmnch)

= (1245mjmnch/#1245spch#)

c = L (mjmnch/mnch)

= S (#1245mjmnch#/1245mnch)

= S (1245mjmnch/#1245mnch#)

d = JTN (mjch/mjch/mjch)

= JTN (a/mjch)

= S (1245mjch/#1245mjch#/1245mjch)

e = JTN (mjmnch/mjmnch/mnch)

= JTN (mjmnch/c)

= JTN (mnch/f)

= S (1245mjmnch/#1245mjmnch#/1245mnch)

f = S (1245mjmnch/#1245mjmnch#)

= S (#1245mjmnch#/1245mjmnch)

...and so on...[48]

To see how these rules may operate so as to produce a brand rather more complex than those examined so far, let us glance at the following derivation (obvious substitutions and permutations not always recorded):

BRAND = J (d/mnch)

= J (JTN(mjch/a)/mnch)

= J(JTN(mjch/S(#1245mjch#/1245mjch) / mnch)

= J(J(mjch/C(1245mjch/1245mjch) / mnch)

= JS (JE (A / CE (J/ L) / Qc

---

[48] To avoid repetition I will not continue with the full set of rules at this time; this will be done once and for all below.

.....which formula produces the following brand:

(2/2/4).

That is, "the Juxtaposition North/South of: (to the North) the Juxtaposition West/East of an 'A' and a 'JL' Combined West/East; and (to the South), a Quartercircle."

1.5. The Unaries Again.

In quite a few cases the abovegiven rules have restricted the classes of unaries which may apply before multinaries are brought into play. In most such cases, the set of applicable unaries was given as "1245" rather than the usual "1-6"; that is, unaries of classes 3 and 6 were excluded from applying. The reason for this exclusion has already been stated: that allowing charges to be attacked by the 3 and 6 unaries before undergoing attack by the more demanding multinaries, would lead to many malformations. Thus, for example, it would be hard to state consistent rules for Combining two charges which had both been altered by the 6 unary FLG.

However, the classes of unary functors which may not apply before the complex multinaries, may apply after them. That is, it is possible to apply FLG to the union of two or even three charges as brought about by previously Combining them. Examples are:

(Sup.1/2/1/4)[49]

(51/1/13)

The Brand Book also displays an example of the 6 unary RKG applied in the same way:

(21/1/10).

In addition, it is rather easy to find a brand containing one or more break-points whose placement is inexplicable in terms of the rules set up for the class-3 unary BRK''---or inexplicable, if you prefer, in terms conformable with the apparent consistency of break-placement in the great majority of the Nevada brands. That is, there are breaks which are best explained, and provided for, as having been introduced after one or another multinary was applied. Just such a brand is:

(60/1/11);

here, the 'S' charge, which has been partly overlaid by the 'W', is broken in a most unlikely spot if one regards the 'S' separately: but the union of 'S' and 'W' is broken exactly where one would expect. (In addition, of course, the serifs have been broken from the 'W'.)

Note that the 3 unary FND must be applicable to the union of two charges; another example of this operation may be found in (73/1/4),

---

49 The fact that the 'wings' of (Sup.1/2/1/4) are broken-off makes this brand no less an example of post-multinary application of the unary functor FLG.

exhibited on page 43, above. Admitting that the class-3 unaries may apply after certain multinaries, of course, admits BOX as one of these late operators. This seems reasonable, even though the Brand Book shows no cases of such an application.

Before proceeding to show how these late applications of the 3 and 6 unaries are to be stated, it is necessary to add a cautionary note. For it would be easy, at first glance, to conclude that if e.g. FLG is to be added after the strong multinaries (like those of the C class), then it would be more elegant to add FLG after the weak multinaries (like those of the J class) as well. In such a solution, e.g. FLG would never be added except at the last minute, consistently throughout the entire system. Against this pleasant treatment, however, there is a convincing counterargument: such a disposition would produce only Juxtaposed brands whose charges were either all FLG or all not FLG. And this would be to rule out e.g.

(55/1/7).

The same argument applies, mutatis mutandis, to e.g. BRK'', in view of:

(58/1/5).

For this reason, any attempt to introduce 'wings', and so on, solely through unary-applications to already-united charges, must be abandoned.[50]

50 On the other hand, there are persuasive reasons for allowing the class-3 unaries to apply to a Juxtaposition of charges; this question will be returned to in Section 4.

To turn now to the problem of making possible these 'late' applications of the 3 and 6 unaries, the method is obvious. We will simply add appropriate indicators to all rules governing 'strong' multinaries wherever the 3 and 6 unaries have been omitted. For example, we will revise the statement of the rule

a = S (#1245mjch# / 1245mjch)

so that it reads

a = 6(3(S(#1245mjch# / 1245mjch)))

...which allows the 3 and 6 unaries to attack the result of binding two charges (neither individually attacked by 3 or 6) by a 'strong' multinary. In like fashion we will revise the other appropriate rules; these revisions, not specially marked as such, will be given in the next section.

Note that in the above reformulation 6 follows 3, hence e.g. FLG must follow BRK'': these late-applied 'wings' cannot be broken off, as the rule is now stated. This minor problem will be reconsidered in Section 4.

1.6. First Approximation to the Complete Iconic Morphology.

It is now time to bring together, at last, all of the foregoing notes on individual features of the Nevada brands' iconic morphology. The formulaic expressions in use throughout this paper allow for a highly synoptic statement of this system; but this statement, hopefully, when taken with the preceding comments, will not be completely opaque.

The final first approximation to the complete iconic morphology of the Nevada cattlebrands now follows.[51]

BRAND = 1-6CH

= a

= b

= c

= d

= e

= J (mjmnch/mjmnch/mjmnch/mnch)

= J (mjmnch/ac)

= J (mjmnch/e)

= J (mnch/d)

= J (c/ac)

= JI (1-6sixspch/1-5sixspchmjmnch)

ac = a

= c

a = L (#mjch#/mjch)[52]

= L (mjch/#mjch#)

= 6(3(S#1245mjch#/1245mjch)))

= 6(3(S(1245mjch/#1245mjch#)))

---

51 Anyone must flinch at the sight of such a phrase as "final first approximation." I have used this oxymoron deliberately, to convey (without putting too fine a point on it) the status of this set of rules.

52 Expressions containing "L"---which can instantiate as "A"---contain markings for dominance; these lie fallow unless invoked when an application of "A" determines a superimposition which forces distortion of one of the two charges involved.

```
      b  =  L (#1-6spch#/mjmnch)
         =  L (1-6spch/#mjmnch#)
         =  6(3(S(#1245spch#/1245mjmnch)))
         =  6(3(S(1245spch/#1245mjmnch#)))
      c  =  L (#mjmnch#/mnch)
         =  L (mjmnch/#mnch#)
         =  6(3(S#1245mjmnch#/1245mnch)))
         =  6(3(S(1245mjmnch/#1245mnch#)))
      d  =  JTN (mjch/mjch/mjch)
         =  JTN (a/mjch)
         =  6(3(S(1245mjch/#1245mjch#/1245mjch)))
      e  =  JTN (mjmnch/mjmnch/mnch)
         =  JTN (mjmnch/c)
         =  JTN (mnch/f)
         =  6(3(S(1245mjmnch/#1245mjmnch#/1245mnch)))
      f  =  6(3(S(#1245mjmnch#/1245mjmnch)))
         =  6(3(S(1245mjmnch/#1245mjmnch#)))
  1-6CH  =  6(5(4(3(2(1(CHARGE)))))))
 mjmnch  =  mjch
         =  mnch
   mjch  =  (any of the 'major charges')
   mnch  =  (any of the 'minor charges')
 CHARGE  =  mjch
         =  mnch
         =  spch
   spch  =  (any of the 'super charges')
```

```
1-6sixspch  = 6(5(4(3(2(1(sixspch))))))
   sixspch  = 'Circle'
            = 'Diamond'
            = 'Box'
            = 'Flatiron'
            = 'Heart'
            = 'Triangle'
1-5sixspchmjmnch  = 5(4(3(2(1(sixspchmjmnch)))))
sixspchmjmnch  = sixspch
               = mjmnch
            L  = J
               = N
               = T
               = A
            S  = C
               = D
          JTN  = J
               = T
               = N
            J  = JE
               = JS
               = JNE
               = JSE
               = JSW
```

$$
\begin{aligned}
N &= NE \\
&= NS \\
&= NNE \\
&= NSE \\
&= NSW \\
T &= TE \\
&= TS \\
&= TNE \\
&= TSE \\
&= TSW \\
C &= CE \\
&= CS \\
&= CNE \\
&= CSE \\
&= CSW \\
D &= DE \\
&= DS \\
&= DNE \\
&= DSE \\
&= DSW \\
A &= AC \\
&= AE \\
&= AS \\
&= ANE \\
&= ASE \\
&= ASW
\end{aligned}
\qquad (109)
$$

1 = STR'' , ENL'' , SPR'''

= Ø

2 = SQR, HIP; HIP'',(CVX;CCV); SSQ; WRP

= Ø

3 = (BRK'', FND); BOX

= Ø

4 = REV, (RTBG''; LTBG'')

= Ø

5 = INV; (RLZY; LLZY)

= Ø

6 = FLG; WKG; RUN; RKG; RNG; (LDG,TRL); SKD; 4SK; 4WG

= Ø

Before leaving this section, I should point out that the above-given unary rules (e.g. "1 = STR'', ENL'', SPR''' ") can easily be re-written so as to accord notationally with the other rules. To do this, however, we must introduce a concatenative symbol, "+" for instance, to permit expression of allowable combinations of instances. Let us take this "+" as commutative, and let us now restate the rules just-cited:

1 = x + y + z

x = STR''

= Ø

y = ENL''

= Ø

z = SPR'''

= Ø

This set of rules may be read as: "In class-1, choose the three symbols 'x', 'y', and 'z', in any order; and then instantiate these as, respectively, either STR'' or zero, either ENL'' or zero, and either SPR''' or zero." Note that the so-called 'zero option' is still present, in that all three of the "xyz" symbols can be instantiated as "Ø".

In like manner the other unary rules can be rewritten in more conventional notation. In some cases (e.g. 2) such restatements will be cumbersome, of course: the reason for their not being used in the earlier expositions.

1.7. Conclusion.

Having arrived now at the end of the section on iconic morphology, a few final remarks and caveats are in order.

First, and most generally, I specifically make no claim that the rules presented above suffice to generate every one of the Nevada cattlebrands. My not claiming this rests only to a trivial extent on the reservation made in the next paragraph; it rests mostly on the realization of the fact that the Brand Book contains quite a few brands for which my rules make no provision at this point. These have been omitted, when not through obtuseness or carelessness, because they seemed to show no systematic regularities, i.e. seemed to form no describable classes, or to represent exceptions to highly general rules. Most of the omitted brands are from the Brand Book's later pages, where miscellaneous brands are exiled; these largely consist, at least in part, of what I have called "super charges", the potential list of which

is presumably endless. (Though there is some sort of upper bound on size and complexity imposed by the size of a cow's hide and the need for a legible pattern which can be formed from iron.) But others are from earlier pages in the Book: between three and four percent of the total of these more "systematic" brands. These I claim to be largely anomalous in one way or another; but some of them could doubtless be accommodated by various extensions of my rules. And this may be done at a later time.

A further reservation has already been hinted at in the section preceding: that syndeictic considerations will force minor revisions in any case. There would be little point now in forecasting what these revisions will consist of, or in showing what related revisions have been deferred until these syndeictic ones can be taken up.

In the same section which presents these revisions, I will also demonstrate the extent to which the iconic morphology has already been influenced by syndeictic considerations. ("Already" = "in the section now ending"). That extent is, surprisingly, rather small.

We now leave the iconics for awhile. It has been observed quite a few times that brands have blazons, e.g. "Open A E Combined"; and that these blazons are syndeictically associated with their brands. Before examining the manner of their association---the principal target at which this paper as a whole is aimed---we will first consider the blazons in isolation, as a describable set of linguistic tokens.

A P P E N D I C E S

Appendix I (List of Primitives) - - - - - - - - - - - - - - -114
Appendix II (Brands as in the Brand Book)- - - - - - - - - - -115
Appendix III (Catalog of Brands) - - - - - - - - - - - - - - -116
Appendix IV (Bibliography) - - - - - - - - - - - - - - - - -119

APPENDIX I

(partial) List of Charges

The full Appendix I will list the charges on which the rules of the Morphology operate, categorizing those charges as 'Major', 'Minor', or 'Super', and providing them with morphophanemic markings where appropriate. As has been pointed out at various places above, these markings will designate the charges' line-termini (as in 'A', below) and break-points (as in 'A', 'B', and 'O', below); in addition, a few charges will have their 'longest line' marked, for applications of STR''.

If there were anything really obscure about where, on each charge, these marks were to be placed, then I would feel constrained to provide a full Appendix I at this time. But all of these matters have been gone over with some thoroughness; hence, since the full Appendix must also contain additional information which would at this point make no sense to the reader, I will here present only a sample Appendix I; which now follows:

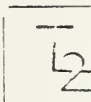
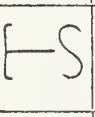
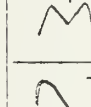
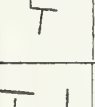
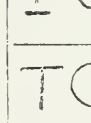
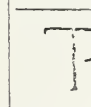
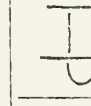
Charge	Class	Line-Termini Circled	Broken at Break-Points
	Major		
	Major		
	Major		
	Minor		
	Minor		
	Super		
	Super		

APPENDIX II

Brands as in the Brand Book

In this partial Appendix II, rather than compiling a partial catalog of all the brands to be used illustratively in all three Parts of this paper, here reproducing as in the Brand Book only those used in Part One, instead I will simply reproduce two-thirds of a page from the Brand Book itself: something which, in any case, ought to have independent interest. Note that, as referenced in Appendix III, below, this page contains four brands illustrated in Part One: (52/1/1), used on pages 94 and 96, above; (52/1/4), on page 66; (52/2/3), on page 24; and (52/2/7), on page 47.

(52)

		Gilmore B. Ross Wa Co. LTH LHC T L Combined Cross Two	1			S.A. Camp Cinning Co. & Kenneth Mebane El & La Cos. LTH LHC T on Lazy S
		John P. Hawes Hu & El Cos. RHC T L Combined Bar	2			Marie, Wm. Joseph & Leroy Antone Streshley & Ceraldine Merle Di Grazia La Co. RSH RHC LHC BD Lazy T S
		C.E. Tipton Hu Co. LTH LRC LNW T L Comb Oc Conn	3			Walter R. Schwake Ly Co. LTH LHC T Lazy S Comb Bar
		Alzola Brothers El Co. LStH LHC DD T M	4			L.T. Turner El Co. LSH T Hanging T
		Giovanni Cerri Hu Co. LSH LHC DD Inverted T N T Comb	5			Frank & Georgie Sicking Ny,Es,Cl & Ch Cos. LTH LRC T Inverted T
		J.A. Gandolfo Est. La Co. RHC BW BD T O	6			R.M. Steele El Co. LTH LHC LRC T Inverted T Combined
		Henry Tom Mn Co. LRC T O M	7			C.A. Or Orene H. Sewell El Co. LTH LHC Inverted T T
		A.R. Pescio WP Co. LSH LRC Finished T P Combined	8			Harold W. Baker Ly Co. RHC Inverted T Over T
		Tony Palacio El Co. LTH LHC T Over Lazy P	9			LDS Reno Stake Welfare Ch Co. LHC LRC Double Lazy T
		Frank & Grace Palacio El Co. LTH LHC T R	10			Bud Vice Hu Co. LTH LRC Double T L

APPENDIX III

CATALOG OF BRANDS

Brand	Reproduced page:	Referred to page:
1/1/1	41	
1/1/3	35,39	36
1/1/6	32,48	
1/1/8	49	50,51
1/1/14	32	
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APPENDIX IV

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Special Acknowledgment

I take pleasure in giving special credit here to Josephine Abbott, of the National Institutes of Health. Except for three or four amateurish ones done by the author, all of the brands reproduced in this paper are Miss Abbott's handiwork; she brought to this task both skill and determination.

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